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ABSTRACT

This report presents strategies for ensuring full participation and achievement in the sciences by women and girls, calling upon all adults to support the interest and persistence of females in science, engineering, and technology. After two introductory special reports, "International Efforts through Beijing +5" and "Toward Equity in the European Union," there are six parts. Part 1, "K-12: Training the Nation's Girls and Young Women," includes "Intel Prize Winners: Working with Resources at Hand" and "Funding: Sara Lee Schupf--Making Science Irresistible for Girls." Part 2, "The Undergraduate Experience," includes "Affirmative Action: Controversy and Opportunity" (Carol Hollenshead and Angela Ginorio) and "Congresswoman Connie Morella--Educating Tomorrow's Workforce." Part 3, "Academia: Graduate School and Beyond," includes "Interventions To Advance Women on Science Faculties in Europe and Canada." Part 4, "Business and Industry," includes "Peer Review in Sweden and the Netherlands" and "Funding: Sloan Foundation--Altering a Male-Centric Work Environment." Part 5, "Conversations about the Future," includes interviews with female education administrators and special reports: "Fatimah Jackson: A Critique of the Human Genome Project" and "A Call for Future Research" (Barbara Lazarus). Part 6, "Resource Guide," includes a directory of resources, science and technology programs of National Council for Research on Women member centers, and organizations and Web sites. (Contains 142 references.) (SM)

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Balancing the Equation

Where Are Women and Girls in Science, Engineering and Technology?

RESEARCHED AND PRODUCED BY
The National Council for Research on Women

WRITTEN BY Mary Thom

ED 455 348

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University of Washington, Northwest Center for Research on Women

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WISCONSIN

University of Wisconsin, Madison, Women's Studies Research Center

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Many believe that the very nature of the institutions where science gets done in the United States and around the world must change—not only to accommodate women but to benefit all science and engineering workers and ensure that their discoveries benefit the planet's population in an optimal and equitable way.

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Supportive mentors, role models, and networks have been shown to be important beginning at early educational levels and continuing throughout a woman's scientific career.

PREFACE

LINDA G. BASCH, *Executive Director, National Council for Research on Women*

We have witnessed a period of heightened activism by and for women and girls in science, engineering and technology over the last decade. At all levels, reformers have launched new educational programs to attract women and girls to scientific arenas, fostered their progress, and made space for their ideas and critiques. Conferences and publications have explored ways to create curriculum and climate changes, especially in such fields as physics, computer science and engineering where few women participate. These efforts addressed glass ceilings and other nuances of exclusion that, despite over two decades of an expanding pipeline, still confine women in scientific leadership positions to single digit proportions. A recent report issued by MIT, which publicly acknowledged that its women faculty had received fewer financial resources and rewards and less laboratory space than their male colleagues, sent deep ripples through the scientific community, animating several more institutions to examine their practices and look more deeply into the causes of these continuing imbalances.

As we begin the new millennium, the scientific community increasingly recognizes that best practices need to be institutionalized, to become more than a patchwork of innovative programs that might cease when funding runs out. There is encouragement for more diversity in the sciences. But while work continues to bring more women of all backgrounds and men of color into the sciences, strategists are now focusing on retaining members of these groups and advancing them to positions of leadership. Can we build on what we have learned over the past two decades to achieve these goals? Can we muster the research, strategic planning and support needed to make possible such major changes in the structure and culture of our institutions?

The National Council for Research on Women (NCRW), a working collaborative of 95 women's research and policy centers, is pleased to issue this report, which addresses these questions. *Balancing the Equation* reports on lessons learned over the past decade and on key challenges, new questions and fresh directions. It identifies areas where we have learned a great deal and moments in the education and career cycle when intervention can make a significant difference. In developing *Balancing the Equation*, NCRW has drawn on a wide array of sources: reports, publications, websites, programmatic initiatives, conference proceedings and interviews with leaders in the education, funding and work arenas. The report is meant to be a synthesis of many efforts underway, and of available information, rather than an exhaustive overview.

As part of NCRW's Research for Action program, the report's goal is to stimulate public debate on the issues presented; to encourage dialogue and collaboration across the borders of research, public policy and activism; and to identify areas for further research. In

keeping with these objectives, each section of *Balancing the Equation* concludes with recommendations to enhance women's and girls' experiences and possibilities in the sciences. It also contains an extensive Resource Guide to courses, programs, websites and funding sources focused on expanding women's and girls' opportunities, and includes descriptions of the programs of the 44 member centers of NCRW that are engaged in significant work in technology and the sciences.

The pages that follow document a number of reasons the voices of women and girls of all cultural, racial and class backgrounds need to be equitably represented in the sciences. There are demographic reasons: the technological and scientific achievements of the past decade and a half have created a heightened need for a scientifically and technologically literate workforce at a time when too few people are available for these positions; and women and girls constitute at least 50% of the available talent pool. Equally important are the valuable perspectives and experiences women and girls bring to scientific endeavors, which lead them to provide different interpretations and ask different questions about such issues as how research dollars are allocated, whom drug testing protocols target, ways to create technology that can help communities, and how to balance career and family demands. As Shirley Ann Jackson, president of Rensselaer Polytechnic Institute, points out in these pages, "If you have myriad social and environmental problems that have to be addressed, you do not have anybody to waste!" And as the report shows, programs that work well for women and girls also work well for men and boys.

While this document focuses primarily on the United States, it also identifies some practices and issues outside its borders. It reports similar glass ceilings for women in many European countries as in the U.S., describes some of the problems women in the southern continents confront, and points to the lack of support from the United Nations and international conventions for the linking of gender to science and technology. And it identifies efforts underway to address these lags. The report also underscores the value of cross-cultural comparisons. As Barbara Lazarus, associate provost of Carnegie Mellon University, puts forth in her concluding recommendations, the attitudes of a society such as Japan—which teaches these disciplines to everyone throughout the curriculum in the belief that people need to work hard to learn math and science regardless of talent—produce a technologically literate population and workforce. These are all areas that need further research.

In looking at the statistics of girls' and women's presence in science and technology and a range of experimental programs in kindergarten through secondary, undergraduate and graduate education, and in the workplace, *Balancing the Equation* identifies strategies that have been successful in increasing female participation. Supportive mentors, role models and networks have been shown to be helpful beginning at early educational levels and continuing throughout a woman's scientific career. Cross- or multi-disciplinary courses that demonstrate

the connection of the sciences to other areas of study like the arts and to social, political and health issues are important at undergraduate levels and beyond. Other useful strategies provide multiple opportunities for entry into the sciences and introductory courses that nurture future scientists instead of the all too frequent "gatekeeper" courses meant to weed students out. Cross-disciplinary applications and opportunities also contribute to the successful recruitment of women to technological careers. The relative absence of these initiatives in physics and computer science departments has been cited as a factor in their low numbers of female students. The report also points to some of the reasons that industry often provides more attractive work environments to women than academia, from which women seem to drop out at every point of transition. It also points to the significant roles heads of departments play in making change possible or in stifling it. As Barbara Lazarus emphasizes, all these environments need more study.

The report also underscores the role played by women's studies programs and women's research and policy centers in creating "safe spaces" for a critical mass of scholars interested in both women's issues and science. It is in these centers that many of the innovative programs, studies and critiques described in this report were launched. They have been fertile environments in which feminist researchers and scientists have raised critical questions about ways to create a more inclusive science and about the foci of various scientific initiatives, like the Human Genome Project. Echoing Karen Barad, physicist and women's studies chair at Mount Holyoke College who is cited in these pages, many of these scholars argue that science, like all knowledge, is socially constructed and must be viewed in context. It cannot be seen as "a fixed body of knowledge with a certain authority behind it."

Woven throughout these pages are the voices of leaders responsible for changing the terrain of the sciences for women and girls. *Balancing the Equation* concludes with the perspectives of four such women—Anita Borg, Donna M. Hughes, Shirley Ann Jackson and Shirley Malcom—on the future possibilities for women and girls in science, engineering and technology. Of varying ages, cultural backgrounds and experiences, their emphases differ. Yet they unite in recognizing that science and technical literacy needs to be improved throughout the population, that to balance the equation in the sciences requires changes in cultural values and practices as well as systemic reform of institutions, and that strong leadership at the top is necessary to effect these changes.

There is room for cautious optimism at the beginning of this new century. We have seen that change is possible, although complex. Over the past decade and a half much knowledge has been gained about strategies that work and about the institutional arrangements, supports, attitudes and funding needed to foster them. It is now up to all of us to put in place those practices and ways of thinking that will enable women and girls to thrive in the sciences, and the sciences to thrive because of women's and girls' heightened participation.

Talent resides in all groups and genders. Therefore if one is really looking at a robust economy based on science and technology, and if you have a myriad of social and environmental problems that have to be addressed, you do not have anybody to waste!

EXECUTIVE SUMMARY

As the economy in the United States and the world grows more and more reliant on a technologically literate workforce, the nation cannot afford to overlook the talent and potential contributions of half the population. Women and girls and others underrepresented in the sciences offer valuable new perspectives that will affect both the goals and practices of technological work and research.

Much work has been done, particularly in the last two decades, to pinpoint the needs of women and girls in science, engineering and technology and to develop programs and interventions to encourage their progress. However, changes need to reach deeply into the culture to permanently alter the institutions where science is taught and practiced. *Balancing the Equation: Where Are Women and Girls in Science, Engineering and Technology?* reports far-reaching strategies that women, and men, have developed to turn programmatic progress into lasting change.

Introduction: A critical moment

The 20th century has seen women struggle for recognition as scientists and engineers, some with notable success. Programs beginning in the 1970s, with increasing momentum in the 1990s, recognize an uneven playing field and attempt to improve women's chances for success. Several events and conditions make this a particularly good moment to evaluate these endeavors and look to the future:

- In the spring and summer of 2000, the international community gathered to assess the promises made in the plan of action passed five years before at the United Nations Fourth World Conference on Women held in Beijing. Issues concerning women and technology were put forth as essential parts of many of the goals outlined in the plan of action.

- The success of the Human Genome Project and other advances mark a leap in technology, particularly in biotechnology where women are poised to make significant contributions because of the relatively large number of women in the field. In health research, a National Institute of Medicine report called *Does Sex Matter?* confirmed that gender differences affect not only the sexual reproductive capacities of humans but biological functions from "womb to tomb." The differences start at the cellular level and must be taken into account more broadly at all levels in biomedical and health research.

- Critical national debates are joined today over such issues as affirmative action and funding for science and technology research; women have a great stake in these policy discussions.

- Women and men in science and technology today seriously question the trade-offs demanded of them in terms of their work and family life, particularly in the demanding postgraduate training stages of their careers.

Even with the considerable progress made by women and girls in science and technology, too many women still feel they learn and work in unfriendly or hostile environments in labs and other technological workplaces. However, in all fields and in major technology corporations, women have formed national organizations and networks to support each other, develop visible leadership for change and advance an agenda of equity. These groups have made considerable efforts to reach out to women and girls of diverse ethnic and racial backgrounds and to those isolated because of cultural factors or geography.

K-12: Training the nation's girls and young women

In the overall effort of recent decades to better educate young people in science, technology and mathematics, girls made rapid progress; the gender gap in science and math achievement has narrowed significantly. However, studies still reveal weaknesses in the training of girls. Young women, for example, exhibit less confidence in their math skills than young men. At higher levels of math achievement, high school boys still outperform girls.

Inclusive, engaging teaching methods developed in programs to encourage girls to perform well in science and technology studies have been found to be very effective for teaching boys as well. Tested programs improve the competence and confidence of elementary school science teachers, and new programs exist to train instructors in information technology and other expanding fields of knowledge. However, innovative teaching methods may not make their way into the mainstream when programs are terminated, for example, because of limited funding. While programs have successfully transformed the educational environment in a particular classroom or a particular school, the challenge of system-wide reform has proved significantly more daunting.

Young women are alarmingly absent from computer science advanced placement classes. According to an American Association of University Women report, girls do not feel computer-phobic; they demonstrate reticence about a technology that seems to them largely devoted to the interests of boys. In such a situation, girls-only computer labs boost girls' enthusiasm. In addition, young women are drawn into computer technology when it is presented not as a set-aside activity but integrated into a subject area that interests them, whether it is history or language, ecology or economics.

Innovative programs for girls and young women provide opportunities for them to interact with women in science and technical fields. Summer residential weekend and weeklong programs allow young women to work with up-to-date equipment. Programs seek to meet the needs of young African-American women and Latinas who are in danger of being left behind. But more research is needed to assess what factors in such programs contribute to a girl's long-range interest and success in scientific and technical fields.

The undergraduate experience

With some exceptions, girls and young women hold their own through high school in math and science, but retention of potential female scientists and engineers becomes more complex at the undergraduate level. Young women tend to begin college study of science and technology with career goals that are less well defined than those of young men. A Wellesley College study identified the first undergraduate year as a significant time when women disproportionately abandon plans to major in science. Women's retention rates grow as they become more comfortable and confident in their technical skills.

Recruitment of women into undergraduate science and engineering programs is the goal of new efforts that focus on community colleges as a source of talent for the technological workforce. Other programs blend liberal arts and science and engineering curricula to attract young women to technical careers.

Educators work to retain women science, mathematics and engineering majors through a variety of interventions. Researchers found that women in science study tend to feel rewarded by praise from professors, while such factors as competition among peers reward men. Mentoring by professors and upper-class students, the opportunity for undergraduates to perform hands-on research and curricula designed to emphasize the problem-solving applications of science and technology are strategies developed to appeal to women in undergraduate science courses.

Within science departments, the educational environment for undergraduate students, both women and men, can be a disincentive. Programs encourage faculties to value undergraduate students and train teaching associates to nurture rather than discourage potential science majors. Advocates advise replacing gatekeeping courses designed to weed students out with curricula that invite students into disciplines that are male dominated, such as computer science and physics.

New curriculum initiatives, designed to draw talented women into technical careers and increase science literacy overall, offer cross-disciplinary approaches that may meld women's studies courses with science training. Other innovative degree programs combine liberal arts and engineering majors.

With leadership from the top and carefully designed research that accurately identifies factors that discourage women, institutions can successfully attract and retain women students even in computer science, where the proportion of bachelor degrees earned by women has been declining. At Carnegie Mellon University, women's share in first year computing classes rose from 8% to 40% over a five-year period. Rensselaer Polytechnic Institute has greatly improved its retention rate of women in engineering and technical majors. Women's institutions—such as Smith College in Northampton, Massachusetts, and Spelman College in Atlanta—have been successful in recruiting women into engineering and other technological majors.

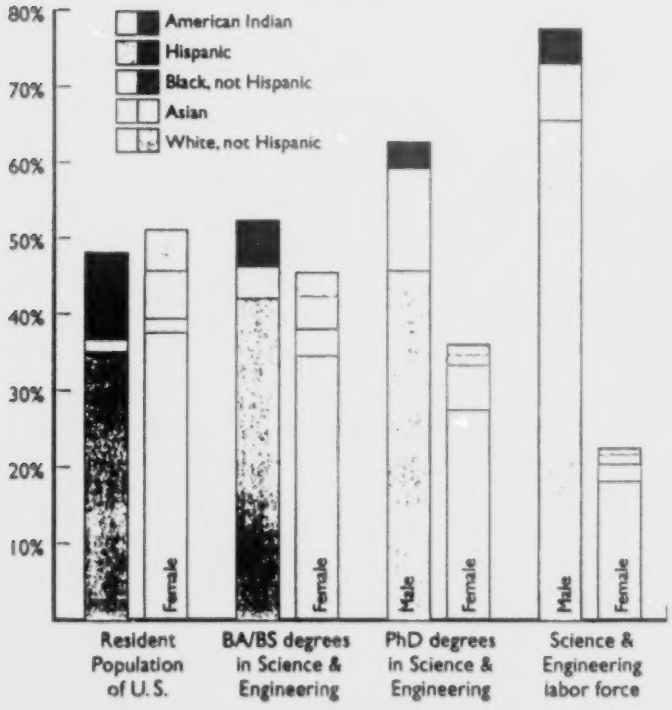
Academia: Graduate school and beyond

In graduate and postgraduate science and technology training, pressures on women and men increase. The time it takes to earn science Ph.D.s—too often more than 15 years from entering college—discourages young academics with family demands, and women tend to drop out at nearly every transition point.

Programs address the need to support women at the assistant professor level so that they can procure tenure track appointments. For example, the Clare Boothe Luce Professorships provide a useful spotlight on women early in their academic careers, gaining them seats on faculty committees and other policy-making opportunities. It recognizes the varied needs of women beginning their science careers by offering flexible stipends that can be used for childcare or for travel to professional conferences.

Despite progress made over the last decade in the proportion of women, men continue to dominate science and technology faculties at the highest levels. Leadership by major institutions can make a difference in keeping talented women in the pipeline so that more attain senior faculty positions and leadership roles in their fields. A survey at MIT that demonstrated how women faculty and researchers have been shortchanged over the years led to changes that increased the productivity of MIT women. Other leading research universities have pledged to make similar efforts to improve the status of women faculty. A new National Science Foundation initiative invites institutions to design programs that will lead to systemic change to improve the status of women in science and technical fields.

PARTICIPATION IN SCIENCE AND ENGINEERING BY GENDER AND RACE



NOTE: Psychology and social sciences are included in the science and engineering category.
COMPILED FROM: National Science Foundation (1999). *Women, Minorities, and Persons with Disabilities in Science and Engineering: 1998*. Arlington, VA. p. 3.

Business and Industry

Many women scientists and engineers leave academic life early in their careers having concluded that industry offers fewer barriers for their advancement. Corporate leaders agree that the bottom line has become a strong inducement to recruiting women and underrepresented minority men, given the continuing needs of a technological workforce.

Still, prior to their entry into the marketplace, undergraduate and graduate science majors need ways to educate themselves about diverse opportunities in the technology workforce, since students in academic settings report

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a lack of information about careers. For example, some four-year institutions offer new degree programs that meld business and management training with science and technology curricula.

Leading corporations in science and engineering concerned about advancing women encourage networking among their female employees to alleviate isolation in a male dominated workplace and to make women leaders more visible. With an eye to the future workforce, forward-looking employers also encourage female employees to be role models for girls and young women in their communities.

Many women scientists and engineering professionals cite the integration of family life and work as a primary concern, particularly since women scientists often marry other scientists so that both partners are affected by the demands of a technical career. Major companies have taken the lead to decrease turnover by offering sabbaticals and work-at-home options. Many women in high-tech jobs leave the corporate workforce to become self-employed contract workers, a strategy that gives them more control over their work schedules.

In the growing biotech industry, women are poised to make major inroads because of their numbers in biology undergraduate and graduate programs. Studies suggest that the scale of biotech work, with many products being developed in relatively small workplaces, provides many opportunities for women scientists and researchers. Still, these same studies show that women are scarce at top levels of research and administration.

Strategists cite information technology as a field that offers women opportunities to choose technical work with social content. In San Francisco, an innovative incubator project, the Women's Technology Cluster, invests in women entrepreneurs launching high-tech businesses and calls on successful graduates to contribute resources to women following in their footsteps.

Into the future

National advocates for women in science and technology stress the importance of leadership at major educational, corporate and government facilities to achieve institutional change. In secondary education and undergraduate studies, a cross-disciplinary curriculum is a key to drawing young women into science and technical careers and improving science and literacy throughout the nation. The need for mentors and networking for girls and women in science begins at the primary school level and continues through graduate education and careers in business and industry.

Only a broad effort based on a wide consensus will transform the culture of science and technology in environments where women and minority men have been discouraged and excluded. To that end, strategists need to look at women's progress in science and engineering in the United States in the context of what women engineers, for example, have achieved in other countries. New research must accurately track the different experiences of women scientists and engineers depending on the community from which they come and the setting in which they work.

Introduction

A CRITICAL MOMENT

Will women biologists and geneticists be sufficiently represented in the ongoing exploration of the genome? Will the needs of women as patients and childbearers be fully respected as genome research is put to work?

When Gertrude B. Elion, a 1988 Nobel Prize winner, went looking for a job in 1937 with her freshly minted, *summa cum laude* degree in chemistry from Hunter College, no one would even consider her for a position in her field. This gifted biochemist, who among other achievements went on to synthesize and co-develop two of the first successful drugs to treat leprosy, was rescued from secretarial school by an offer of a three-month job as a hospital lab assistant. When not one of the 12 schools where she applied for a graduate school position even bothered to answer her, she was forced to apprentice herself to an organic chemist she happened to know. World War II labor shortages persuaded industry to be more receptive to women scientists, and she eventually landed a position at the Wellcome Research Laboratories of the Burroughs Wellcome pharmaceutical company.

The four decades of Gertrude Elion's distinguished career at Burroughs Wellcome saw dramatic changes in the status of women in science and engineering. Yet today, as we enter the 21st century, the position of women in these professions is still tenuous. Many question whether women scientists will continue their progress toward achieving gender equity. While doors have been opened, in some fields wider than in others to be sure, there is still no guarantee that talented girls and women will not be discouraged in many subtle ways on the long path from primary school to university to building a career. Many believe that the very nature of the institutions where science gets done in the United States and around the world must change—not only to accommodate women but to benefit all science and engineering workers and ensure that their discoveries benefit the planet's population in an optimal and equitable way.

Representatives from around the world gathered in New York City in the summer of 2000 to assess progress on the promises made at the United Nations Fourth World Conference on Women held in Beijing five years before. These promises included a guarantee of access to technology and development. Now is a critical time to pause and look at women in relation to science and technology. It is a moment of historic importance in biotechnical fields, with the announcement on June 26, 2000, that the first survey of the entire human genome sequence is complete. Will women biologists and geneticists be sufficiently represented in the ongoing exploration of the genome? Will the needs of women as patients and childbearers be fully respected as genome research is put to work? In addition, the National Institute of Medicine's 2001 report called *Exploring the Biological Contributions to Human Health: Does Sex Matter?* calls on researchers at all levels of biomedical and health research to take into account sex-based differences that can be traced from "womb to tomb," starting at the basic cellular level.

Information and communication technology has begun to explode in its impact on our lives in ways that could either democratize access to knowledge or further exclude those on the margins of society. At the very time software and systems are proliferating, women's future in

the computer industry is a concern. The proportion of women awarded bachelor's degrees in computer science at major universities in the United States, which seemed to be heading toward 40 percent in the mid-1980s, sank well below 20 percent by 2000 *(Eisenberg 2000)*.

Finally, it is a time when policy decisions are being made that will control future educational and career opportunities for women scientists. Most directly, the manner in which federal funds are awarded is important to women's future in science and technology. "Federal policy influences the development of all our human resources, all segments of the population," argued Daryl E. Chubin, senior vice president of policy and research at the National Action Council for Minorities in Engineering, Inc. "The composition of the science and engineering workforce and the nation's workforce in the 21st century is very much in the hands of the way the federal agencies award moneys in the name of research and development" *(Selby 1999a: 237)*. Other policy issues currently under debate at the national and state level and within institutions and corporations include the use and misuse of standardized testing, which is a $200 million a year industry in the U.S., the future of affirmative action, and practices that affect the interaction of work and family life, a balancing act particularly daunting for young scientists and engineers, both male and female.

Diversity—for the sake of science

Women's progress in science and engineering seems to have reached a crossroads. The nation has arrived at a consensus that diversity is an important goal. "Women have always included technology and science in *their* choices and successes," said Cecily Cannan Selby, a biologist and science educator who in 1998 convened a conference at the New York Academy of Sciences to reassess the status of women 25 years after the academy's landmark 1972 meeting on the topic. "But not until today," she added, "do we hear voices raised to say...that science and engineering enterprises must choose women for their own successes" *(Selby 1999b: xiii)*.

In too many cases, funding for a model program threatens to dry up before its success or failure is fully measured or before strategies are developed for infusing a successful approach into the mainstream.

The gender equity requirements embodied in Title IX of the Educational Amendments of 1972 were further spelled out for women in science with passage of the 1980 Science and Engineering Equal Opportunity Act. The act states: "It is the policy of the United States to encourage men and women, equally, of all ethnic, racial and economic backgrounds, to acquire skills in science, engineering and mathematics, to have equal opportunity in education, training and employment in the scientific and engineering fields and thereby to promote scientific and engineering literacy and the full use of the human resources of the nation in science and engineering."

Over the next 20 years, hundreds of programs were launched to advance gender and ethnic diversity—programs to identify forms of classroom discrimination, for example, and to discover how girls and women can best be encouraged to learn scientific concepts. Other programs focused on why girls and women tend to abandon science and math pursuits in greater proportions than male students and colleagues. Classroom, laboratory and corporate cultures were scrutinized to determine specifically how the climates encourage or discourage gender and ethnic diversity.

Women's progress remains uneven among various fields as well as among different age, ethnic, or socioeconomic groups.

National women's organizations were formed, as were networks within corporations and academic disciplines—among the most important, the Association for Women in Science (AWIS), founded in 1971. Major conferences have brought leading scientists together to assess progress and address new issues over the years. The 1994 Women in Science Summit, for example, sponsored by Mills College, looked at the relatively neglected issue of the status of women in the top ranks. Conference participants created an extensive plan of action directed toward several constituencies: academic department chairs and faculty, university administrators, chief executive officers in companies and heads of government laboratories, officers of professional societies and officers of foundations and funding institutions *(Mills College Women's Leadership Institute 2000: 1, 5)*. Yet equity remained elusive. For example, women are 46 percent of the U.S. labor force but only 23 percent of its scientists and engineers *(National Science Foundation 2000: 51)*. For AWIS, parity for women at 50 percent is still an ideal, but its target date for achieving that goal is now 2020.

To reach that goal, major changes must be accomplished. Sue V. Rosser, dean of the Ivan Allen College at the Georgia Institute of Technology in Atlanta, designed a survey to measure the degree to which science and engineering laboratories remain a man's world. Via email, she canvassed 98 women scientists who had received Professional Opportunities for Women in Research and Education (POWRE) awards in 1997 from the National Science Foundation. She measured their responses according to a five-stage model, where in stage one, no one even noticed the absence of women, and stage five represented a "laboratory climate redefined and reconsidered to include us all." The largest number of respondents were in the middle, stage three, where women were considered an anomaly, a problem; they were challenging lab culture by demands for maternity leave, for example. None had entered a stage five environment, though the response of one stage four scientist suggested what that might entail. She reported:

> In the laboratory climate, I am able to create and build; I am also able to ask

SPECIAL REPORT

INTERNATIONAL EFFORT

Adapted from reports in
AWIS MAGAZINE
(Association for Women in Science),
Vol. 29, No. 4, Fall 2000

SCIENCE AND TECHNOLOGY in general, and particularly issues concerning women, have been underemphasized by international programs at the United Nations and elsewhere, according to Marilyn Carr, senior economic advisor for the UN Development Fund for Women and a senior fellow at the Radcliffe Public Policy Center. Carr made her argument at a June 2000 forum in New York City that was part of a five-year assessment of progress made since the 1995 UN World Conference on Women in Beijing.

The UN once maintained a fund and department for science and technology, but those issues and their funding were then dispersed throughout the UN system. When a Commission on Science and Technology for Development was reconstituted in 1994, it was located in Geneva, and had little visibility. And the once very active Science and Technology Department of the World Bank closed in the 1980s, Carr noted.

Issues of gender and science and technology have received little support at the UN, said Carr, and officials have often been openly hostile to concerns being raised at women's forums. She credits non-governmental organizations for pushing these issues at the Beijing conference. Although no science and technology plank was included in the Beijing Platform for Action, these topics were included in many of the sections.

But more followup is urgently needed, said Carr. Although women worldwide practice science and technology every day, when the value of their knowledge is recognized, it is often in danger of being appropriated by international corporations that "make huge profits by commercializing knowledge that is not their own." Carr gave several examples. Because international law allows the patenting of life forms that are altered, she said, neem, a pesticide used by women farmers in India for centuries, now has 35 patents in North America and Europe. An American company is trying to patent a form of turmeric for healing wounds, a traditional use of the foodstuff by Indian women.

American scientists are developing a commercial sweetening product

THROUGH BEIJING+5

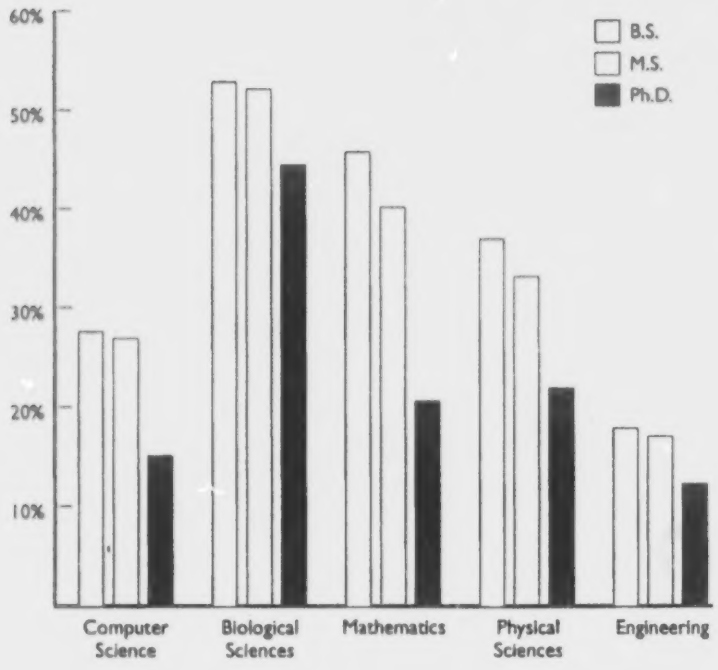
from brazzein, a berry used as a sweetener in western Africa. And shea butter, made from nuts collected by women in western Africa and used for cooking, skin cream and medicine, is being marketed in the industrialized West with "patents and market domination ensuring that profits go to retailers instead of to the communities where the raw material originates."

In order to protect women's interests as producers, said Carr, rural women need assistance in improving technologies. To cut out the middlemen in the chain, they need increased access to information about prices and markets.

At the same forum, Irene Muloni of Uganda spoke of the daunting barriers facing girls in her country who want to become scientists and engineers. Muloni, manager of information technology for the Uganda Electricity Board in Kampala, described the struggle of Namataka, a student at a girls' school in the mountainous eastern region of Uganda. Matters have improved in much of the country because free primary education was mandated in the 1990s, but a fifth of students drop out before completing four years of schooling; and two-thirds of those dropping out are girls. Namataka has poor English, but she is a promising mathematics student, and she is determined to continue her studies. But before she runs the three miles to her school, she must gather water for her family and feed and dress her younger brothers and sisters. Discouraged by her mother from technical learning, she manages to do her homework during lunch. But she has no time to read.

Muloni met Namataka through her work as secretary general for the Association of Women Engineers, Technicians and Scientists in Uganda, formed in 1989 to encourage more women to pursue technical careers. A pilot project in the Mbale area where Namataka lives brought together schools, local authorities, district leaders and the private sector to build and equip a science laboratory. Despite a promise of equipment from the Ministry of Education, however, the project was stalled when the community failed to complete the building. Girls like Namataka fight the odds. In Ugandan rural areas, 59.1% of women, and 29.5% of men, remain illiterate. ■

PERCENTAGE OF WOMEN AMONG GRADUATES BY SCIENTIFIC FIELD



"Our country underutilizes major components of its human resources: women and minorities."

COMPILED FROM: National Science Foundation. *Women, Minorities, and Persons With Disabilities in Science and Engineering: 2000*. Arlington, VA. pp. 120, 170, 175, 180, 188, 189, 195

for help and delegate responsibility. Sometimes my colleagues ask me for help. There is a hierarchical structure at the laboratory in which I work, but it is more fluid; roles switch as projects come through. Sometimes I will take the lead and other times I will follow. In terms of my career, working in a laboratory offers a fantastic opportunity to work alone, work with a large group and manage a project, offer support to a colleague, and to build a small community *(Rosser 1999: 99–100)*.

The work of assessing the different programs and techniques of the last 20 years is critical in order to open further what remains largely a man's world and move from patchy improvements to widespread institutional change. In too many cases, funding for a model program threatens to dry up before its success or failure is fully measured or before strategies are developed for infusing a successful approach into the mainstream.

Women's progress in science and engineering remains uneven among various fields as well as among different age, ethnic, or socioeconomic groups and geographic locations. Institutions must focus on the bottlenecks that exist, where opportunities suddenly narrow for women pursuing science in the academy and industry. They must strive to retain women scholars and workers and make both the work and study environments flexible enough to allow reentry of those who have been unnecessarily discouraged or have taken time off for family reasons.

While progress seems slow, anecdotal evidence shows that the goals of women scientists may be shifting. A lunch discussion at the New York Academy of Sciences 1998 meeting compared what women said they wanted to achieve with the aspirations of women scientists at the 1972 meeting. The answers in the early 1970s were fairly direct: women wanted the recognition of their peers. In the late 1990s, peer respect was expected by the women. A new consensus defined success by assessing all aspects of life—satisfaction in career, family and personal life *(Baker 1999: 210)*.

Signs of progress

However elusive the ideal, women embrace the challenge of science and engineering at the beginning of a new century. More women are visible in positions of leadership. Rita Colwell, former president of the American Association for the Advancement of Science, is now director of the National Science Foundation. Shirley M. Tilghman, a molecular biologist, was chosen 19th president of Princeton University in May 2001. On the international front, Gro Harlem Brundtland, a physician and former Norwegian prime minister, is the first woman to head the World Health Organization, with a staff of 4,500 and a billion dollar budget.

Frances Allen, a fellow at the IBM T.J. Watson Research Laboratory, described this moment as "an extraordinarily exciting time in science. Having seen about 40 or 50 years of it in my field, there has never been a time like this. The computing field is just the beginning. That excitement is happening in biology and other fields as well. I think women have many good reasons to pursue science" *(Mattis & Allyn 1999: 160)*. James Preston of Avon Products pointed out that more than half of all scientists that the world has ever known are alive and working at this moment of "unprecedented worldwide opportunity and growth. Countries that we never dreamed of reaching are suddenly reachable; markets that have been closed to development for decades are now open for business; and people from every corner of the earth are looking to industry for the answers to their needs and the opportunities to fulfill their dreams" *(Preston, J. 1999: 19–20)*.

The global arena of scientific work today presents extraordinary demands. "Leadership in science and technology in the next century will play the dominant role in determining world economic power and the resolution of problems related to health and the environment," wrote Francine Essien, a biologist at Rutgers University. "It is well acknowledged that in order for the United States to sustain its leadership in these areas, it must take advantage of the skills and talents of all its people. Yet our country underutilizes major

SPECIAL REPORT

TOWARD EQUITY IN THE EUROPEAN UNION

Adapted from **ETAN REPORT ON WOMEN AND SCIENCE** *(European Technology Assessment Network) 2000, 82–83*

THE EUROPEAN TECHNOLOGY ASSESSMENT NETWORK, in its 2000 report on women and science, made a number of recommendations to the European Union and its member states. Noting that, compared to the United States, equality laws in Europe tend to lack teeth, the report proposed an EU directive for legislation to require employers to keep data by gender so that practices could be monitored for equity.

New legislation was recommended to achieve a better gender balance on public committees. The report noted that the Finnish Gender Equality Act required public bodies, including National Research Councils, to have a minimum of 40% of both genders. Italian legislation required a membership of at least 30% of each gender on committees that conducted competitions to hire and promote people, for example, at universities and research councils.

The report asked all member states to pass laws to facilitate access to public documents. Finally, it called on countries to eliminate restrictive laws and practices. For example, a German regulation that limited assistant scientist positions to five years worked against women who took maternity leave. Other laws banned women who were pregnant or breast-feeding from laboratories. The report recommended that guidelines should be available instead. □

components of its human resources: women and minorities" *(Essien 1997: 101)*.

The growth of the women's studies movement, and the accompanying development of a critical mass of scholars interested and trained in both women's studies and science, has provided the opportunity to raise new questions in the sciences and bring forth new perspectives. Donna M. Hughes, director of the Women's Studies, Science and Engineering Curriculum Project at the University of Rhode Island, wrote that she was "appalled that I could receive a Ph.D. in genetics and never learn about eugenics"—particularly the assumptions of genetic inferiority that facilitated the Holocaust. She fears that without serious reform of the current curriculum, a new generation of decision-makers will be ill-prepared to deal with ethical issues that arise in scientific work. "We have arrived at a time in which some people again have the power to decide whether some lives 'are worth living,'" she explained, referring to the Human Genome Project; she pointed out that pregnant women are often the focus of genetic testing. "Science students need to have a social context for considering the use of their science, and humanities students need to understand enough science to evaluate the meaning and implications of the science" *(Hughes 2000: 307, 310–311)*.

In such a dynamic setting, the opportunity to advance the goals of equity and inclusiveness must not be lost. As Cecily Selby put it, "We've progressed to the point where we recognize that it's not simply a matter of figuring out how women, and others who have been excluded, can be made to 'adjust' to an alien environment. We're daring to dream of making the environment of science and engineering inviting to every person who has the talent and the desire to participate in the scientific enterprise" *(Goldberg 1999: 15)*. Realizing that dream, she added, will benefit not only the women and men who work in these fields but the disciplines of science and engineering and society as well.

PART 1 K–12: TRAINING THE NATION'S GIRLS AND YOUNG WOMEN

"I play sports for the rush of getting the kill in volleyball or—I play goalie in soccer—making that save. The sense of discovery in science provides that same thrill. I was the first person finding these things out."

Research over the last two decades has advanced our knowledge about how schoolgirls and high school women succeed in mathematics and science. In the nation's overall push to better prepare all students in these areas, girls have made rapid progress, particularly in their increased participation in science and math courses, including advanced classes. The National Council for Research on Women's *Girls Report* shows that, as a result of such advances by girls, the gender gap in science and math achievement has narrowed considerably *(Phillips 1998: 57)*. Model programs designed to render a skeptical girl enthusiastic and comfortable in a pursuit that may have been seen as boys' territory have created more inclusive teaching techniques and curricula that can reach all students, whatever their gender, ethnic background or economic status.

Young women who persevere in advanced technical study are being recognized in greater numbers. Because studies show that in math, for example, girls tend to be less confident of their skills than boys *(Phillips 1998: 59)*, the visibility of girls singled out for their achievements is critical in changing the way their female peers think about science and math fields. The International Science and Engineering Fair, now sponsored by Intel, has been held for half a century. Twenty-five years ago girls were about 25% of ISEF finalists; by 1998, they were 47%. And young women won the top prize in the two most recent competitions. (See *Intel Prize Winners—Working with Resources at Hand,* page 36 in this report.)

But gaps still exist. Innovative teaching does not automatically make it into mainstream classrooms, and girls in poor and rural areas and students of color may not experience enough of the benefits that model teaching techniques offer. Increased performance levels by female students account for more than half the national improvement in test scores in the last decade, yet young women still score lower than males on Scholastic Aptitude Tests (SATs)—results that tend, however, to underpredict women's first year college grade performances. In a 1996 assessment of performance levels for science, there was a small but statistically significant shortfall in the performance of 12th grade female students compared to males, though the scores for grades 4 and 8 were not significantly different between girls and boys. In math, girls' performances matched those of boys for average students, but at higher levels of achievement, male grade school and high school students outperformed females *(National Science Foundation 1999: 24–26)*.

In addition, both male and female students in the United States lag behind students in many industrialized countries in both math and science. Measured by the Third International Mathematics and Science Study (TIMSS), U.S. students in the fourth grade performed above the international average in math and science, but U.S. high school seniors were behind. Students in all but one of the 16 participating countries outperformed seniors in the U.S. taking advanced math *(Takahira et al. 1998)*.

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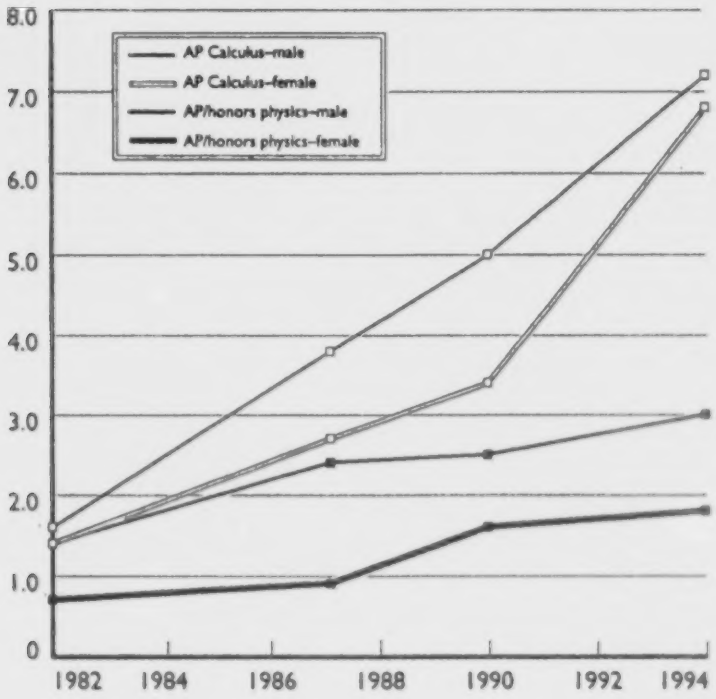
PERCENTAGE OF GRADUATES TAKING AP CALCULUS AND AP/HONORS PHYSICS COURSES IN HIGH SCHOOL, BY GENDER



COMPILED FROM: National Science Foundation (1999). *Women, Minorities, and Persons With Disabilities in Science and Engineering: 1998*. Arlington, VA, p. 146.

Although the TIMSS figures show that high school students in the U.S. are less likely to be taking math and science courses in their senior year than their counterparts in other countries, this trend may be changing. Growing numbers of young women in this country study high school math and science, and both females and males increasingly register for the tougher, more advanced courses in the upper grades *(Zemke 2000)*. Female students today are as likely as males to complete high school math courses, whether algebra and geometry or trigonometry and calculus. In science classes, young women are slightly more likely to take biology and chemistry and slightly less likely to take physics *(National Science Foundation 1999: xiii)*. Among advanced placement test takers, women represent 55% of those taking the biology test, 47% of the calculus test, 42% of chemistry, and 35% of physics. Young women tend more than in the past to have taken the required courses to begin a science or math major in college. Still, as noted in

the next chapter of this report, evidence suggests that upon entering college, women tend to have less definite ideas than men about preparing for careers in math or science.

In computer sciences young women are alarmingly absent from advanced classes. Female students compose only 20% of those taking the Advanced Placement (AP) test and only 12% of those taking the more advanced computer science AP exam *(National Science Foundation 1999: 28, 158)*. But their relative absence from computer studies does not indicate computer-phobia. Rather, according to MIT professor Sherry Turkle, a member of a commission sponsored by the American Association of University Women that studied the problem, girls seem to express a reticence, a 'we can, but I don't want to' attitude toward the technology *(American Association of University Women 2000: x)*. When girls do take computer classes, they are more likely than boys to go into data-entry and clerical study. In the Fairfax, Virginia, public schools, women constituted a majority of word processing and desktop publishing students in 1998 but were severely underrepresented in business courses on computer programming and artificial intelligence *(American Association of University Women 2000: 41, 46)*.

Educating the teachers

Many of the science-enrichment programs of the 1980s and 1990s addressed gender only incidentally, as part of a broad-based effort to improve the U.S. teaching record in science and math. For example, the National Science Foundation solicited bids for Statewide Systemic Initiatives to reinvigorate science teaching at the local level. Eventually the NSF funded teaching initiatives in 25 states and Puerto Rico, as well as 25 urban areas with significant pockets of poverty and rural areas such as Appalachia and the Navajo Nation. In 1991, during the first wave of funding, Ohio launched its local reform initiative, Project Discovery, under the directorship of Jane Butler Kahle and Nobel Laureate Kenneth Wilson. Focusing on improving the knowledge and skills of middle school science teachers throughout the state, Ohio's Project Discovery was one of the few statewide programs with a goal of bridging gender, ethnic and socioeconomic gaps in science and math achievement.

Innovative K–12 programs show that girls are drawn into math and science through active, cooperative learning settings rather than competitive, individualistic approaches.

The project reached out to math and science teachers through intensive six-week Summer Institutes, leadership programs and district-level workshops. The program's systematic approach ranged from revising teacher accreditation programs, to enhancing use of technology in schools and to "increasing public understanding of the need for a scientifically and mathematically literate citizenry." An early two-year internal study showed that students of Discovery teachers performed consistently better in math and science than students of non-Discovery teachers in the same

schools. The study's directors reported that "both girls and African-American students in Discovery classes demonstrate significantly higher levels of achievement in both science and mathematics than their peers in comparable non-Discovery classes." A later five-year study generally confirmed the results, although the Discovery class students' achievements in math was more pronounced than in science.

After five years, NSF funding for Discovery expired, and the extent to which the improvements would be mainstreamed became a question. However, Ohio's initiative received funding from the state legislature, and, by 1999, it had reached more than 10,000 math and science teachers. Two new components, added in 1996, address long-term needs: Project Sustain focuses on the state's undergraduate preparation of math and science teachers; Tech Prep works with business and industry to prepare high school students for technological occupations *(Project Discovery Home Page)*.

According to Discovery's founding director Jane Butler Kahle, her studies dating from the mid-1980s and others show that girls are drawn into math and science through active and cooperative learning settings rather than competitive, individualistic approaches. Girls benefit from learning groups, unless they are isolated or badly outnumbered by boys in the group. Their performance is also enhanced by fieldtrips, discussions and counseling *(Kahle 1996: 61–62)*. Many boys do well with such enhancements, too. Such environments help all students see the relevance of science and math in a wider frame of environmental and social concerns.

These and other findings informed Operation SMART (Science, Math, and Relevant Technology), launched in 1985 by Girls Inc. to encourage hands-on, inquiry-based after school programs that inspire girls to acquire the skills necessary for the high-wage technical jobs of the future. In 40 states across the country, at a cost of about $129 per girl a year in established programs, more than 425,000 girls ages 6 to 18 have participated in programs using Operation SMART techniques.

The following principles guide Operation SMART:

- ❑ assume girls are interested in math, science and technology;
- ❑ let girls make big, interesting mistakes, rather than protecting them from risk, so that they learn to trust their own judgment;
- ❑ help girls resist pressure to behave in sex-stereotyped ways, for example, by encouraging them to get grubby digging in a river bed or exploring a car engine; and,
- ❑ expect girls to succeed.

Studies by several Girls Inc. affiliates indicate that girls who participate in Operation SMART gain more favorable attitudes toward science and become more likely to think of themselves as potential scientists *(Allen 1999/2000, Imoyase Group 1999, LeCount 1990, Rogg 1991)*.

Operation SMART was developed as an informal educational program to be offered primarily in after school settings. Girls Inc. affiliates across the country also have used the program during school time. Girls Inc. of Rapid City, South Dakota, obtained Girls Inc. permission to develop an elementary teacher training program based on Operation SMART as a way to reach rural girls and boys with hands-on science and gender equity initiatives. The teacher program, called Teaching SMART, was evaluated in a five-year project to observe how the training is adapted in individual settings.

Researchers looked at teachers trained in Operation SMART techniques in seven classrooms in Rapid City. One fifth grade, African-American teacher reported that the program made her "much more aware" of the need for equity. "I make a special effort not to give extra time to the males although I do have some very shy boys that I try to get more involved." She does not see her girls "being stifled at this point but then I am sure it does happen later in the grades." She believes the equity methods she has learned from Teaching SMART work equally well with any student who is quiet and withdrawn *(MacKenzie 1999, 24–26, 44)*.

Only 16% of schools in low-income communities have high-speed Internet access, compared to 37% in higher-income communities.

One white teacher whose third grade class was evaluated had shied away from science lessons for two decades. This veteran teacher said that her idea of hands-on science had been one student doing an experiment and everyone else passively watching. Now, in a lesson about weathering, she first challenged her students, whom she called Scientist Emily or Scientist Ashley, to imagine themselves inside a rock on a cold, rainy night and to ask themselves what happens when water oozes in. She assigned the children tasks to perform while observing chalk they placed in a cup of vinegar. "What do you think is happening? Is there anything you could do to make it dissolve faster?" she asked. "You are the scientists. You do the exploring." Some students reached in to feel the sediment. Ashley suggested putting the cup in the sun. Some students recorded their observations, others consulted books or asked and answered each other's questions. The teacher concluded the activity by gathering the children around and suggesting they continue the exploration at home.

This teacher has experimented with different groupings and discovered that having one boy in each team encourages the girls to take risks. "Often the girls are more apt to do only what was suggested.... The girls help the boys by showing the need to stay on task, using

SPECIAL REPORTS

INTEL PRIZE WINNERS—Working with Resources at Hand

WHEN VIVIANA RISCA, A HIGH SCHOOL SENIOR from Long Island, New York, won the coveted Intel Science Talent Search award in 1999, she told a reporter that the competitor who impressed her the most among the 40 finalists was a young woman from Florida who persevered with her research project without the impressive mentor and facilities that Risca had available (Finn 2000). Risca, who won with a project of encoding a message on a strand of DNA, had the guidance of Dr. Carter Bancroft at Mt. Sinai School of Medicine. The young researcher she admired, Helen Wiersma of Okeechobee, Florida had to travel two hours to a lab where she did some of her research to find a way to control Tropical Soda Apple, a weed that was threatening her small, agricultural community.

Helen Wiersma spent four years developing a method to kill the weed, which involved the application of benevolent bacteria and reduced levels of herbicide. Her work was being submitted for publication in a scholarly journal. She grew up in a family of cattle ranchers, and the exotic weed that invaded the area in the late 1980s thrived in the open grazing lands. She started thinking about her project "purely because I saw a need in my community and I wanted some way to help them." At first, she had no support from her high school teachers, though members of her family were very encouraging and found time to drive her back and forth to the lab. In her sophomore year, she had a "really awesome chemistry teacher" whose family was also in agriculture and who had come back to teach in the school he had attended. "After my freshman year when I managed to prove myself," said Wiersma, "he is what kept me going."

The experience of traveling to Washington, DC, as an Intel finalist was "wonderful," said Wiersma. "For the first time I was around people who shared my curiosity and determination. It was interesting, too, because a lot of people have a stereotype of a scientist, and we completely broke that stereotype." Her roommate was a singer and an actor, she explained. "We had artists there. I'm into sports. We were really so diverse, and the love of science drew us together." She hopes that girls are not turned off by inaccurate notions of what a research scientist does, because "science can be a very creative pursuit. That's why I love it."

Wiersma accepted an offer extended to Intel finalists to intern for the summer at the Merck laboratories in Rahway, New Jersey. Many of the interns continued with their line of research, "but since mine was with agriculture, I couldn't, so I completely branched out." She had an interest in molecular biology but never the resources to pursue it. "At Merck, I could. I turned into a workaholic." Wiersma uses an analogy to explain the intensity of her love for

what she has decided will be her life's work. "I play sports for the rush of getting the kill in volleyball or—I play goalie in soccer—making that save. The sense of discovery in science provides that same thrill. The work I was doing at Merck was not that important, though it was important in academia, but I was the first person finding these things out."

She took her enthusiasm to the University of the South in Sewanee, Tennessee. "It's a liberal arts college, and I value being in a diverse setting. Actually, I'm considering minoring in art history." She finds her courses in cellular biology and molecular biology "extremely challenging. I'm in a lot of upper level classes, and I'm the only one who hasn't been exposed to AP classes—my high school didn't offer AP classes in math or science." But Helen Wiersma does not believe that children need fancy facilities to learn to love science. Speaking of her Intel experience, she said "some of the best projects have come out of people's garages. It's natural curiosity that is fostered at a very young age. I have a twin sister, and we always used to make messes in the kitchen, doing little experiments. It's just nurturing that curiosity, being encouraged to ask why."

The top winner in the 2000 competition, announced March 12, 2001, is also a young woman. Mariangela Lisanti, a senior from Staples High School in Westport, Connecticut, won for a project that used single atoms or molecules to fabricate electronic devices. Lisanti, who developed a measurement apparatus for allowing extremely fast data acquisition, was lucky enough to be able to conduct her research at Yale University, but in another respect, her project was like the ones Helen Wiersma described: the equipment for her experiment, including two wires and a stereo speaker, cost only about $35. ■

Philanthropist Sara Lee Schupf: Making Science Irresistible for Girls

Sara Lee Schupf is a philanthropist who thinks carefully about the daily needs of the people whose lives she tries to affect. For girls who are potential scientists, this means paying attention to their families and communities so that it is easier for the adults in the girls' lives to support their interest in science and technology. The National Council for Research on Women asked Schupf about funding priorities she has identified.

Most important to me is to create visible role models, which means more women in science, because what I'm really concerned about is getting young girls interested and keeping them interested. If not enough women are in the pipeline, I think these young girls are losing out. It's a tough road and they need mentors. They've got some obstacles that can make it really, really difficult in science. They need to see others that have done it and are fulfilled and happy. I see, I can do. If you don't see, you don't do.

Right now, we're funding a teaching intern program at Emma Willard School. The intern is a recent college graduate who is interested in teaching and is a scientist. For one or two years, she

SPECIAL REPORT

Sara Lee Schupf

continued

lives in the dorms with the students. To have a young woman scientist living in the dorm—living, breathing, playing and accessible—gives the girls an opportunity to see and learn that science is not for others but for them. Hopefully this program will encourage more young women to be interested in science.

Also, we initiated and help fund the Weizmann Woman and Science Award, which is a biannual award that is given to outstanding women scientists. One of the criteria for the award is what they do for others. All of our awardees are not only outstanding scientists but wonderful and caring mentors. They are extremely interested in supporting young women. The current awardee is Carla Shatz. She recently was appointed chair of the neurobiology department at Harvard Medical School. Almost all of the outstanding women scientists that I have met are very well networked and are working together in many different ways to strengthen the recognition and visibility of women scientists and to encourage more young women to continue their interests in science.

Currently the project that I am most interested in is one that we hope to be doing with the National Academy of Sciences. It is an autobiographical series of books on women in science written for middle school girls. I feel strongly that, if done well, it could make a big impact on creating more visible role models to stimulate a young woman's interest in science. I would also like to get parents, especially mothers, to understand the importance of being scientifically literate. Science is not for others, and it is not only for half the population. How can we expect daughters to stay interested in science if they see their mothers' lack of interest and understanding?

The New York Academy of Sciences is addressing the need to help parents connect to science. It has recently initiated a website called Science EduNet. All activities and programs relating to science in New York City are posted and updated. Soon this site will include Connecticut and New Jersey as well. It is user friendly so that parents, teachers, museums and all science related institutions are networked and have access to all programming going on in their fields of interest.

I happen to be a puzzle person, and I love working with the computer. It is addictive and a never-ending challenge, but with perseverance solutions can be found. That is what science is all about. Science is really a process of questioning, a process of discovery. That makes science irresistible.

I try to educate women about philanthropy, in addition to encouraging them to be scientifically literate. If we can get them scientifically literate and educated about philanthropy, we will see an increase in the funding for women in science. I know the task before me is difficult, but it will not happen without women's dollars. □

common sense instead of trying something that might be dangerous, and having the boy share with clean up responsibilities or recording data." She has become known in her school as the preeminent third grade science instructor. She thinks Operation SMART techniques are particularly good for those students with learning problems or distracting home situations, and many children in the program are from economically disadvantaged backgrounds. "These are great kids, but their needs are many," she told the study's observer. The program "helps them experience science in a non-threatening way. It helps them escape for a time from a world that is not always nice to them" *(MacKenzie 1999: 42–43)*.

Another statewide program to make teachers sensitive to gender equity issues was launched in Georgia in the early 1990s. Five universities responsible for training the state's public school teachers joined forces to assess math and science teaching in primary and secondary school classrooms. Through the Integrating Gender Equity and Reform Project, or InGEAR, the coalition offered gender equity training for faculty on five campuses, including the state university, a historically black college and a part-time commuter school. InGEAR's strategy is to work with the faculty who instruct the state's teachers, because, in a field marked by shortages and the resulting high demand for young teachers, innovation can be disseminated quite rapidly.

Beth Farokhi of Georgia State University, one of InGEAR's principal investigators, found that strategies designed to include girls and promote gender equity work for all students—something that Teaching SMART teachers experienced as well. InGEAR encourages faculty to consider how often they call on students and the types of questions they ask male or female students. "We discovered that good teachers want to be better teachers," said Farokhi. "When you do the right things, you want to do them for all students, whether they're male or female. When we focus on the females, we're not neglecting the males by any means. We're trying to integrate equitable practices for all students."

A method for teaching mathematics targeted to reach African-American girls in disadvantaged urban neighborhoods has been developed by University of Florida at Gainesville psychologist Carolyn M. Tucker. Using self-empowerment strategies for math improvement in grades one through 12, she reported that 75 African-American female students from low-income families got higher grades and showed more interest in their math studies. Her program involves teaching the girls self-motivating and reinforcing methods. It also emphasizes what she calls math-success behaviors: asking for extra homework, sitting near the front of class or volunteering for special projects. In an atmosphere where "some African-American children regard such success behaviors as 'acting white,'" she challenges teachers and community leaders to encourage these actions *(Tucker 2000: 145–153)*.

Calling all girls

Some of the most creative new programs directed at gender equity address a phenomenon described as girls' computer reticence in the AAUW commission report released in

2000, *Tech-Savvy: Educating Girls in the Computer Age*. Some programs address the paucity of role models, which makes it difficult for girls to imagine themselves in science or engineering careers. Others target such populations as girls in rural areas to encourage their achievement in math and science studies.

Fox Lane Middle School in Bedford, New York, opened a computer lab several years ago. At first, no girls came. An attentive science teacher asked several girls why they did not attend, and she determined that girls might be drawn in if they were not so outnumbered. She established a few girls-only computer lab hours and began asking students during classtime who planned to attend the lab that day. When one girl raised her hand, others followed. Before long the computer lab became "cool" for girls as well as boys, and soon the lab was used equally by boys and girls *(Lombardi 1997)*.

Through the mid-eighties, observed Anita Borg of the Institute for Women and Technology at Xerox Palo Alto Research Center, computers were not commonplace in homes; and boys and girls came through secondary school without experiencing unequal participation. In contrast, she said, today there is a severe imbalance in software that appeals to girls; and there are still too few attempts to address boys' tendencies to hog the computer *(Borg 1999: 102–103)*.

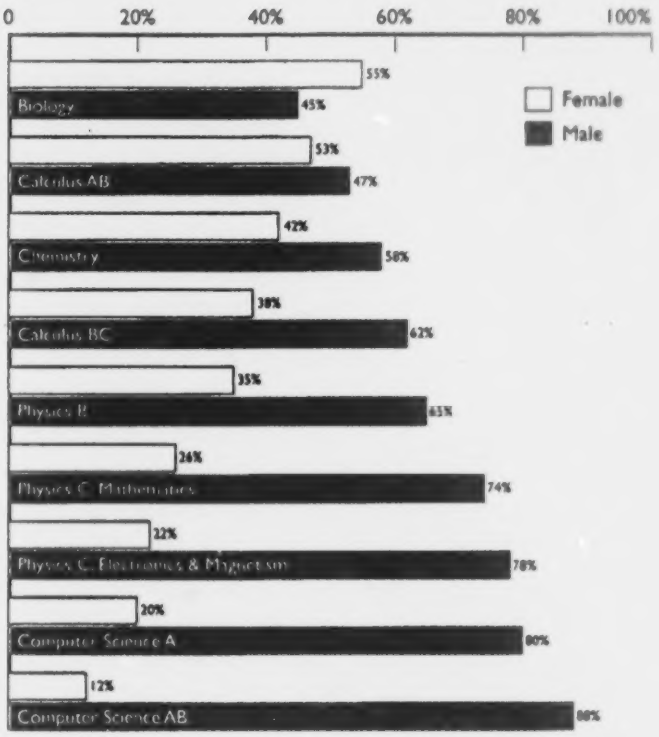
"I think girls want more of a challenge. We've developed a sense that we want to go out there and do something and make a difference."

One problem identified in *Tech-Savvy* is teachers unprepared to deal with the new technologies in their classrooms. Schools had computers installed generally before classroom teachers were adequately trained to use them and certainly before any discussion of equity issues. "Teachers are concerned about managing technology-enriched classes," the investigators found. "In particular, some express fears about maintaining their authority and the respect of their students in the wired classroom" *(American Association of University Women 2000: 19, 21–22)*. In April 2001, Intel announced a pilot teacher-training program that would help solve such problems.

The AAUW commission tried to discover what was behind girls' attitudes toward the computer and the Internet. Too often, girls' concerns about the technology "are dismissed as symptoms of anxiety or incompetence that will diminish once girls 'catch up,'" the study warned. When one looks more closely, girls expressed attitudes that to them were quite reasonable. They tended to present the Internet as a vice in the hands of boys and a virtue in the hands of girls, given the boys' tendency to "play games and fool around while girls use it as a source of information." One female Fairfax high school student was dismissive of the young men who were already working at computer jobs. "Guys are more into it because right now, it's the fastest and easiest way to make money," she explained. "It doesn't take a lot. You don't have to have a

Close to 70% of high school women who attend Smith College's Summer Science and Engineering Program go on to become science majors, many of them at Smith.

ADVANCED PLACEMENT CANDIDATES IN SELECTED SUBJECTS BY GENDER



COMPILED FROM: National Science Foundation (1999). *Women, Minorities, and Persons with Disabilities in Science and Engineering: 1998*. Arlington, VA, p. 158.

college degree to do it. All you have to do is take six months of computer courses, and I know a lot of guys who have done that.... I think girls want more of a challenge. We've developed a sense that we want to go out there and do something and make a difference, and guys just want to make money" *(American Association of University Women 2000: 59–61)*.

Paramount among the remedies suggested in *Tech-Savvy* was the recommendation that computers should not be treated as a "set-aside" lab-based activity but should be integrated into subject areas such as art, music and literature. "This integration supports better learning for all, while it invites more girls into technology through a range of subjects that already interest them." The report also recommended that programs encourage girls to "tinker" with the technology so that they are not just consumers. "Tinkering with code need not be seen as less artistic than tinkering with color, form, and shape. The fact that it is seen as such depends in large part on the way our culture has 'constructed' mathematics, science, and computer science as uncreative," the report said *(American Association of University Women 2000: xi, 10)*.

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Until such cross-disciplinary integration of technology occurs, labs and special programs that create female-only areas for computer use remain effective strategies. The Sophie B. Wired Computer Cluster Project at the Newcomb College Center for Research on Women at Tulane University was opened as a "feminist collaborative learning space" in 1997. In addition to working with the Tulane community, members of the cluster hosted workshops for local middle school and high school girls. Called IMAGINE (Internet Mentoring as Girls' Imagination-Nurturing Engine), the workshops cover the basics of Internet navigation, online identity, and elementary website design, emphasizing how to use the Internet to help with college and career planning.

"Perhaps the most impressive thing was watching the girls in the IMAGINE program—roughly 75% of whom had never been on the Net before—grasp the potentials of electronic networking," explained Crystal Kile, a member of the cluster. "You could see little light bulbs going off in their heads as they realized the vastness of the information out there on everything from their favorite music groups to colleges and scholarship opportunities. Then they discovered chat rooms." It was difficult for Crystal Kile and her co-instructor, Lisa Pollack, a Tulane Ph.D. candidate in physics, to follow their lesson plan, given the girls' desire to explore. "The girls usually won," she said. The two instructors settled into roles as "roving mentors, providing tech support if a machine crashed and circulating through the computer cluster working with them" *(National Council for Research on Women 1998)*.

In 1999, according to Educational Testing Services, 56% of Advanced Placement test takers in all fields were female, but 90% of Computer Science AB test takers were male as were 78% of Physics C candidates.

One middle school girl in Madison, Wisconsin, who was hooked on computers, did not wait for outside intervention. In 1997, Susannah Camic found herself just about the only girl in her middle school computer labs. Many of her female schoolmates had been put off by such things as the attitude of the lab instructor, who became angry when the system overloaded as a result of student mistakes. The girls stopped experimenting and began avoiding the lab. To rectify the situation, Camic founded the Lilith Computer Group in four Madison schools. Among their activities were trips to sites on the University of Wisconsin campus where computers are used in various endeavors. The girls visited a virtual reality engineering lab, dance studio, department of textile design, biotechnology center and meteorology lab. By 1999, they had inaugurated an annual Lilith Computer Fair to reach out to more Madison girls *(American Association of University Women 2000: 54–55)*.

Susannah Camic was an unusual self-starter in a situation where many girls need role models to help them imagine what their futures in math and science might be. Mentoring is key to

a NSF-funded program at Arizona State University that offers career development intervention that is "relationship-oriented." Also with support from NSF, the Association for Women in Science (AWIS) has established residential learning communities at 12 sites across the United States, with an overall goal of "the humanization of science, the development of individual skills and talents, and the establishment of some form of community by which that process can be repeated and perhaps institutionalized." Among the program's various activities is matching scientists with high school and grade school students *(Rayman & Stewart 1999: 63–64)*.

A one-week residential program at Bentley College in Massachusetts funded by the Patrina Foundation exposes young women entering their sophomore and junior years to career options that integrate business and technology. Participants in Get Wired Get Hired have met with women executives from Polaroid and Napster, while working with state-of-the-art technology. Patrina and other funders around the country sponsor Sonia Kovalesky High School Mathematics Days along with the Association of Women in Mathematics. Named for a 19th century Russian-born mathematician and women's rights advocate, the program encourages college math departments to reach out to high school girls.

The Ms. Foundation for Women, in its ninth annual Take Our Daughters to Work day in April 2001, encouraged similar encounters of girls with professional women in technical jobs. Emphasizing the practical and creative uses of technology, the foundation formed partnerships with technology companies and organizations. Girls and parents learned how to design a website, created games and animation, took career oriented quizzes and engaged in moderated web chats to connect to women role models and mentors. To involve parents in advancing girls' technological skills in an ongoing way, Girls Count was founded in 1991 by the Women's Foundation of Colorado and US WEST Women. The organization, which became a separate nonprofit group in 1995, provides resources for parents and educators through its website and publications.

Discover Women in Science, Math and Technology, another source for role models for young women, was developed by the Center for the Advancement of Public Policy in Washington, D.C., under a grant from the Department of Education. Designed as a curriculum supplement for grades 6 through 12, the multimedia CD-ROM, released in 2000, features 54 women representing diverse ethnic backgrounds who currently work as scientists, mathematicians, computer scientists and engineers. The program also provides an overview of fields, resources and historic references on women in science.

In a regional approach, Girls, Math and Science, based at Family Communications, Inc. in Pittsburgh, targets middle school girls in southwestern Pennsylvania with positive messages about their future in technology. The group's communication strategy is directed toward the girls and their parents and teachers. It is building a database of resources, which draws on national sources as well as local businesses and corporations to build a technologically literate workforce.

Some women in industry have taken the initiative to reach out to young people in their communities. For example, the IBM Watson Technical Women's Network in

Armonk, New York, encourages its members to participate in Engineers Week at local schools, among other activities *(Mattis & Allyn 1999: 173)*. At the Jefferson Lab of the Department of Energy, a program called BEAMS (Becoming Enthusiastic About Math and Science) brings entire classes of fifth and sixth graders to the site for a full week of immersion in the high-tech environment. "Over 75% of the students are female or minority," reports Beverly Karplus Hartline, a White House advisor on science and technology. One measured impact is that girls become aware that women can pursue scientific or technical careers. In Jefferson Lab-sponsored lectures to middle and high school audiences, about half the presenters are women and a third minority members. Similarly, in its competitive summer internship program for high school students, about half the participants are female and a quarter young men and women of color *(Hartline 1999: 201–202)*.

A focus on geographically isolated girls is offered by the Northwest Center for Research on Women at the University of Washington. Funded by NSF, the Rural Girls and Sciences Program encourages girls' participation in science and engineering, with particular attention to social issues such as parental involvement and mentoring. In rural communities, the issue of access to science education is central, argued the program's director, Angela Ginorio, often because of "tracking," a practice highly correlated with socioeconomic status. In addition, she said, for many non-white, working-class girls, the choice of science as a career can create both physical and psychological distance since it involves leaving family and community. The program has been successful in maintaining its participants' commitment to science, said Ginorio, but she worries about future funding priorities.

The Association of Women in Mathematics sponsors Sonia Kovalesky days in high schools, named for a 19th-century mathematician and women's rights advocate.

Tech-Savvy emphasizes the problems of underserved students. Only 16% of schools in low-income communities have high-speed Internet access, compared to 37% in higher-income communities. There is concern that uneven access is compounded by the fact that, as opposed to formal classrooms, labs and clubs are the places where "the most intensive, playful, and unstructured learning happens for students.... Yet these voluntary spaces, so crucial to giving students without home access time on the computers, tend to exaggerate gender and racial differences more than classrooms" *(American Association of University Women 2000: 13, 53)*.

In another AAUW report, published in 2000, *¡Si, Se Puede! Yes, We Can: Latinas in School*, co-authors Angela Ginorio and Michelle Huston identify particular problems for Latinas, who have a high school graduation rate lower than girls of any other racial or ethnic group. They are also under-enrolled in gifted and AP courses, and they are less likely than other

groups of young women to complete a bachelor's degree. However, by many measures, Latinas perform better than their male peers. By the 8th grade, Latinas register higher math scores; and by the 12th grade, they do better in science than Latinos. But Latinas are outperformed by their male peers in math SATs *(Ginorio & Huston 2000)*.

Smith College runs one program that has successfully reached out to girls in minority communities. Smith sponsors a four-week residential program for talented girls with a strong interest in science, and over 40% of them are students of color. The Smith Summer Science and Engineering Program (SSSP), founded in 1990 and directed by a 1981 Smith graduate, Gail Scordilis, offers girls an opportunity to perform hands-on research with Smith faculty. Close to 70% of SSSP participants become science majors, many of them at Smith. The college also sponsors a summer workshop for middle and high school math and science teachers and guidance counselors to develop strategies for encouraging young women and students of color to persevere in science and math courses. The teacher workshop overlaps with the SSSP program so educators can observe the girls performing successfully at a high level *(Borrett 1999: 26)*.

RECOMMENDATIONS AND CONCLUSIONS:

- **Exercise leadership at all levels—school boards, superintendents, school principals and deans and parent and teacher organizations—to incorporate gender equitable practices that can lead to systemic change.** Programs have identified practices over the last two decades that increase the success of girls and young women, as well as underrepresented students of color, in mathematics, science and technical study.

- **Pay attention to science and technology literacy throughout the community, knowing that children do not learn in a vacuum.** Provide opportunities for parental involvement in promoting a girl's interest in science and technology.

- **Develop support for mathematics and science teachers, taking advantage of local resources.** Draw on the surrounding business, technological and academic communities to enrich the tools available to teachers and advance their continued learning and career options. At the elementary level and beyond, institute training and teacher development programs to keep educators abreast of new technology and methodology.

- **Support and develop program and funding strategies that infuse into the mainstream the best practices developed in experimental programs for technological learning.** Promising techniques may be lost if strategic planning fails to provide an opportunity for incorporating changes throughout schools in a community or state.

- **Recognize and encourage learning styles and interests that evolve from the experience of girls and young women.** In some cases, girls-only labs or study environments can enhance the confidence of young women undertaking studies in a traditionally male-dominated field.

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- **Stress active and cooperative learning, particularly at primary school levels.** Programs have demonstrated that girls learn well in group settings, with curricula emphasizing such participatory activity as field trips and hands-on experiments. Good teaching methods and environments developed to encourage girls in science, mathematics and technology have been found to work well for boys as well.

- **Demonstrate to young women that technology presents powerful ways to have a highly positive impact on society.** Help students, who may associate technological advances with environmental and social problems, see the connection of science and technological work to solving such problems. Let them know about the people-helping aspects of a future career in science and technology. Highlight the creative and application elements in middle school and high school curricula, so that students do not feel they are simply gathering mechanical knowledge about numbers or computer codes.

- **Encourage activities that integrate science and technology learning with other disciplines.** For example, computer lab Internet exploration can be used in cross-disciplinary ways to enhance a student's existing interest in art, history and literature.

- **Provide girls and young women with mentors from local campuses, research facilities and corporations.** Encourage the leaders of those institutions to reward employees for working with the students who will constitute the talent and workforce of the future.

PART 2 THE UNDERGRADUATE EXPERIENCE

From the mid 1970s to the mid 1990s, programs to support women in engineering have contributed to a rise in undergraduate degrees awarded to women from 2% to 17%.

Despite some serious gaps discussed in the last section, young women students of science, math and technology manage to hold their own through high school. Young men may test higher on the SATs, but young women, overall, achieve higher grades; and their participation in science and math classes, including the tougher courses, has increased steadily. But retention of potential female scientists and engineers becomes more complex at the undergraduate level.

The proportion of women who graduate with bachelor's degrees in science and math varies widely depending on the field of study, continuing a pattern begun in secondary schools, with women gravitating toward the life sciences rather than physics or computer science. By 1995, women reached parity with men in biological and agricultural sciences, earning 50% of these undergraduate degrees compared to 29% in 1975 *(National Science Foundation 1999: 171)*. Women earned 53% of undergraduate degrees in biology in 1996, 19% of physics degrees, 46% in math and statistics, 28% in computer science, and 18% in engineering *(National Science Foundation 2000: 120)*. One theory suggests that college women are more likely to study medicine and biology than physics or engineering because they tend to perceive technical fields as thing-oriented, rather than people-oriented. "Girls are raised with helping, people-focused attitudes, so they tend to stay away from these fields," said Jane Daniels, director of the Clare Boothe Luce Program at the Henry Luce Foundation and former director of the Women in Engineering Program at Purdue University. "Young women are bothered by the negative stereotypes, which persist."

In computer science particularly, the image factor, as it has developed over the last 15 years, may explain the significant decrease in the numbers of bachelor's degrees women are earning. In 1984, when the field was relatively new, women earned 37% of undergraduate degrees. In 1999, they earned fewer than 20%. A study by Tracy Camp, associate professor at the Colorado School of Mines, projects that by the 2001–2002 school year, if trends continue, women will constitute only 16 to 16.5% of undergraduates in computer science at universities that offer Ph.D.s in the field *(Eisenberg 2000)*.

In the 1970s and early 1980s, explained Anita Borg of the Institute for Women and Technology at the Xerox Palo Alto Research Center, when many women headed into computing, "there was no pervasive cultural stereotype about what this field was; it was wide open as something different, with no assumption that this wasn't a place for women." That assumption developed, she believes, through years of classroom and play situations "with boys elbowing girls away from the computers because we haven't figured out how to structure classrooms for equity" *(National Council for Research on Women 1999)*.

The leaky pipeline

By the early 1990s, science educators had become alarmed about the rate at which women—and to a lesser extent men—were abandoning science, math and engineering majors. Women were dropping out of these fields of study at a rate of 70% compared to a male dropout rate of 61% in national samples. At elite schools, 54% of women left these majors compared to 39% of the men *(Seymour & Hewitt 1997)*. A similar fall-off affected the workforce. Women composed 33% of those earning undergraduate and graduate science and engineering degrees, but only 20% of technology professionals *(Didion et al. 1997)*.

This concern led to several studies, including a seven-campus survey of how gender socialization affected students' choices. As University of Colorado at Boulder sociologist Elaine Seymour discovered, particular differences between female and male students' approach to science can be observed at the very start of their college careers. "On entry, women had less well-developed views of what they wanted out of college than did male freshmen, less clear ideas about what drew them intellectually to a particular major, or what they wanted from it in career terms," explained Seymour *(Seymour 1999: 120)*.

At elite institutions in the early 1990s, 54% of women were dropping science, math and engineering majors compared to 39% of the men.

Other investigators agree that the movement away from science starts early in a woman's college career. The Wellesley Pathways for Women in the Sciences project, which in the early 1990s began to track the progress of undergraduates and alumnae, found the first year in college a particularly significant point when women disproportionately abandon plans to major in science *(Cvian et al. 1997)*. In computer science, other research suggests that women tend to evolve an interest in the technology over time, so the typical first-year "killer" computer courses designed to weed out students rather than invite their participation may be overly daunting to women thinking of entering the field *(American Association of University Women 2000: 44)*.

Anecdotal evidence exists that as women's comfort and confidence grows, so do their retention rates in scientific study. Harvard chemist and Nobel Laureate Dudley Herschbach described how, when he began teaching large freshmen chemistry classes 15 years ago, few women students chose to sit in the first rows. Now, he reported, more women occupy those rows, and, though the proportion of women in the introductory course has grown only modestly from about 40% to 50%, the number of female majors has grown from typically eight per year to about 20, or 40% of all chemistry majors at Harvard. In 1998, women were three of the four top A students. "We don't really know why such changes have happened," said Herschbach. "My impression, reinforced by many conversations and also by experience with graduate students, is that young women now feel much more con-

fident of their abilities and prospects as scientists" *(Herschbach 1999: 70)*.

For their seven-campus socialization study, Seymour and her co-author Nancy M. Hewitt looked at how women science and math students achieve such confidence, noting that the female students had more of a tendency to perform for others while males seemed encouraged to be more independent. Thus women tended to switch degree fields if they went unrewarded by praise from teachers, while men were motivated by such things as competition among their peers *(Seymour 1999: 119)*. One female math student said she and other female students tended to overreact when they did not see themselves making sufficient progress. "It was all because, as hard as we tried, we just could not seem to please the professors." She would get nauseated before exams, though in the end she was able to make adjustments and continue her major. "Eventually, I learned not to take it to heart. It's not you they're grading: it's just your work—and not always that. Men just blow it off" *(Seymour & Hewitt 1997)*.

Because women may interpret a lack of encouragement as discouragement, suggested the authors of the study, instructors who believe they are treating students alike—that is, impersonally—may undermine their female students. The investigators found an exception to this tendency toward discouragement among African-American women, however—a group of students who were "distinctively inner-directed and determined, compared both with most other women and with most black men" *(Seymour 1999: 122)*. In fact, African-American women earn proportionately more science and engineering undergraduate degrees than black men. The same is true for Latinas and American Indian women compared to their male peers, in contrast to white and Asian women *(National Science Foundation 2000: 22)*.

In deciding to pursue a science or engineering major, the importance of encouragement from parents and high school teachers was emphasized by women in both the Seymour and Hewitt survey and the Wellesley Pathways report. Both studies found that women who switch out of technology majors are not rejecting math and science as much as they are affirmatively choosing other interests. They may change to other majors in the belief that they will get a better overall education.

The Wellesley women stressed the opportunity to do research as undergraduates as a significant factor in decisions to remain with a science major. The experience of undergraduate research was cited at a gathering of women scientists who had been Clare Boothe Luce Professors, participants in a major program to jump-start the careers of young, promising female faculty. Introducing women early to science applications, they agreed, would help pique their interest. The young professors suggested curriculum adjustments to address the problem of

In a Wellesley College study, women stressed the opportunity to do research as undergraduates as a significant factor in decisions to remain a science major.

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SPECIAL REPORT

AFFIRMATIVE ACTION: CONTROVERSY AND OPPORTUNITY

By **CAROL HOLLENSHEAD**, director of the Center for the Education of Women, at the University of Michigan and **ANGELA GINORIO**, director of the Northwest Center for Research on Women at the University of Washington

THE PRACTICE OF TAKING AFFIRMATIVE ACTION TO ADDRESS INEQUITIES first emerged in the 1960s, when one did not need to look far to see widespread evidence of discriminatory practices by employers and educators alike. Today, with affirmative action programs under attack, much of the debate tends to ignore the complex forces that resulted in the need for such policies in the first place.

According to the U.S. Civil Rights Commission, affirmative action is "any measure, beyond simple termination of a discriminatory practice, adopted to correct or compensate for past or present discrimination or to prevent discrimination from recurring in the future" *(Bruno 1995: 1)*. Beginning in the 1960s, several Executive Orders requested that federal contractors make special efforts to recruit, train, and employ members of underrepresented minority groups. Title VII of the 1964 Civil Rights Act—broadly prohibiting employment discrimination on the basis of race, color, religion, sex or national origin—referred to remedial action required of employers who had previously engaged in discriminatory practices *(Bruno 1995; National Council for Research on Women 1996)*.

As President Lyndon Johnson declared in a 1965 speech, "It is not enough just to open the gates of equality. All our citizens must have the ability to walk through those gates. ... We seek not just equality as a right and a theory but equality as a fact and as a result" *(Bruno 1995: 2)*. Affirmative action is one means of transforming the theory of equality into results. The history of women's access to higher education in the United States illustrates the complexity of privilege and exclusion that such programs sought to address.

In 1833, nearly two centuries after the founding of Harvard College in 1636 made higher education possible for "new world" men, Oberlin became the first college in the United States to admit women. After the Civil War, women began to make progress in gaining more widespread access to education, so that by 1900, 40% of college students were women. This success triggered a backlash that resulted in enrollment reductions for women and their increased segregation into separate academic programs and campus organizations *(Bordin 1999)*.

World War II temporarily opened some doors for women, but between 1945 and 1956, the GI Bill and the influx of soldiers returning from World War II and Korea restricted openings for women in higher education. Only 3% of the millions of veterans enrolled under the bill were women. Preferential treatment in admissions and financial assistance benefited not only members of the armed forces but men generally. To accommodate returning servicemen and their families, admission standards were changed, married student housing built and courses added. In effect, post-war policies constituted the largest affirmative action program this nation has yet experienced and greatly benefited

"It is not enough just to open the gates of equality. All our citizens must have the ability to walk through those gates."

white men who did not come from privileged backgrounds. The nation benefited as well when an educated workforce became increasingly important to economic growth. Nevertheless, men and women of color and white women were largely excluded from the expanded educational opportunities afforded white men. Even women fortunate enough to pursue higher education faced additional barriers to matriculation in "men's" fields of science, mathematics and engineering.

Passage of Title IX of the Higher Education Amendments Act of 1972 marked a watershed in expanded educational opportunities for girls and women. Federally assisted educational programs were comprehensively barred from discrimination on the basis of sex. Public schools had to open mechanical drawing and shop classes to girls and to provide equal athletic opportunities. Institutions of higher education could no longer restrict women's enrollments or financial assistance. While litigation continues to be necessary to enforce Title IX, its success is undeniable.

Although affirmative action guidelines for education were never issued at the federal level, the principles of affirmative action that many colleges and universities applied to their recruitment and admissions practices served to increase access for underrepresented minorities of both sexes and for white women. William G. Bowen and Derek Bok demonstrated that affirmative action programs were very successful in insuring equity in admissions processes in highly selective colleges and universities *(Bowen & Bok 1998)*. A study of Michigan Law School graduates since 1970 showed that there were no statistically significant differences by race in the rates of passage on bar exams, income or satisfaction with the profession. In a recent review of more than 200 scientific studies of programs, Harry Holzer of Georgetown University and David Neumark of Michigan State University noted that affirmative action helped increase the percentage of blacks attending college by a factor of three and the percentage of blacks enrolled in medical school by a factor of four since the early 1960s *(Weinstein 2000)*. Programs to increase women's participation in fields where they are underrepresented have succeeded as well. For example, in the two decades from the mid seventies to the mid nineties, special programs to support women in engineering have contributed to a rise in undergraduate degrees awarded to women from 2% to 17% *(National Science Foundation 2000: 119)*.

Just as women's success at the beginning of the 20th century set off a backlash against women in higher education and the professions, so too has the increased visibility and success of women of all races as well as underrepresented minority men triggered opposition. Affirmative action is under attack, despite the fact we are far from achieving either

SPECIAL REPORT

Affirmative Action
continued

race or gender equity in higher education. By 1995, the backlash against affirmative action reached official levels. The University of California regents voted to end special admissions programs that year, and a citizen referendum confirmed that choice a year later. A Texas circuit court ruling in 1996 banned affirmative action in admissions and financial awards. Two years later, a state of Washington referendum was passed to prohibit any "preferential" treatment on the basis of race, gender, national origin or ethnicity. In July 2000, an administrative law judge upheld Governor Jeb Bush's plan to end the consideration of race and gender in admissions in Florida state colleges *(Lauer 2000)*.

Underrepresented students of color—African Americans, American Indians, and Latinos and Latinas—most immediately felt these restrictions as their applications dropped during the first year following the measures in both California and Washington. Some argue that the fall-off at elite state universities was offset by increased registration at less selective colleges and universities. In the area of science this is significant because the majority of science professionals is produced by highly selective research institutes *(Morrett 1998)*. A decrease in diversity at elite universities is damaging in itself, according to a December 2000 ruling that upheld a University of Michigan undergraduate admission policy that, following the Supreme Court's rationale in Bakke v. Regents, University of California, uses race as one of many factors in determining who is admitted. Federal District Court Judge Patrick J. Duggan found that "a racially and ethnically diverse student body produces significant educational benefits such that diversity, in the context of higher education, constitutes a compelling governmental interest." Months later, however, another federal judge on the same court threw out an admission program at the University of Michigan's law school, ruling that the system was based on race and unconstitutional. Judge Bernard A. Friedman's ruling in March 2001 was expected to send the conflict to the U.S. Supreme Court for resolution *(Wilgoren December 2000; 2001)*. In the meantime, in a state of Washington case against admissions procedures at the University of Washington School of Law, the 9th District Court of Appeals declared that the process by which race was included as a factor in admissions was legal by federal standards. The lack of federal guidelines for affirmative action in student admissions has led to many different types of practices that are now being acted upon in the courts.

Researchers have demonstrated that all students learn better when exposed to students unlike themselves. A landmark study by Patricia Gurin found that white students who had the most experience with racial diversity had higher scores on a test of complex thinking, more motivation to achieve and higher levels of citizenship *(Haas 1999)*. Similarly, advocates for increasing the presence of women in science and math argue that new questions and new paradigms develop from a learning community that represents diverse points of view. In an amicus brief supporting the University of Michigan, 20 of the largest U.S. corporations argued that students educated in settings with diverse student bodies "are better prepared to understand, learn from and collaborate with others from a variety of racial, ethnic and cultural backgrounds; demonstrate cre-

ative problem solving by integrating differing perspectives; exhibit the skills required for good teamwork; and demonstrate more effective responses to the needs of all types of consumers" *(University of Michigan 2000)*.

The challenge to affirmative action comes largely from those who resist diversity. Nevertheless, response to that pressure could have some positive results if it serves to trigger a useful reexamination of conditions that call for such a remedy *(Orfield & Miller 1998)*. A direct attack on the causes of unequal access is embodied in a lawsuit initiated in California. The American Civil Liberties Union sued the state on behalf of a high school student, Rasheda Daniel, for denying her equal access to advanced placement curriculum. Admission to the University of California system is heavily weighted in favor of AP course takers, who receive five points for an A compared to four points for an A earned in a regular class. Rasheda Daniel's neighborhood school, Inglewood High School, offered only three AP courses, while Beverly Hills High School offered 14 *(Sappenfield 1999)*.

"A racially and ethnically diverse student body produces significant educational benefits such that diversity, in the context of higher education, constitutes a compelling governmental interest."

The U.S. Supreme Court is expected to reexamine Bakke within the next three to five years. If it is overturned or even if it is confirmed to one degree or another, institutions will be well advised to find new or additional ways to address race and gender imbalance. For example, whites tend to perform better on SATs than African-American and Latino students, and criticism from affirmative action opponents has already led to a healthy de-emphasis of SAT scores at several institutions—including public universities in Texas, Florida and Massachusetts. Following the lead of Mount Holyoke and other small colleges, the president of the University of California recently proposed ending the use of SATs as a requirement altogether *(Schemo 2001)*. "There has been a kind of reductionism in higher education, reducing students to numbers, reducing institutions to numbers," commented Mount Holyoke President Joanne V. Creighton *(Wilgoren June 2000)*.

We applaud the efforts in our own and other institutions of higher education that have maintained their commitment to diversity in the face of significant opposition. In the area of science, the gains in access that have been made by white women in some areas of science still do not translate to equity, and access for underrepresented ethnic minority women and men in science and engineering is still far from equal *(Campbell et al. 2000)*. Whether mandated by new laws or the courts, institutions that are compelled to redefine affirmative action implementation must examine their own practices that perpetuate discrimination. As long as the goal of eliminating inequities guides these examinations of practice, they will lead to changes that may be as beneficial as those intended by affirmative action. Strategies and specific laws may change, but the vision of equity under the law remains a compelling one. ■

undergraduate women's tendency to drop out as science majors while few drop in. In addition to research opportunities, they suggested that arranging the courses so that a science or math major could be completed in three years would accommodate those who might come to science a little later in their college careers (Baker 1999: 213).

The seven-campus study found that the decision to abandon a commitment to science was easier for women from economically advantaged families and less common among black women, older women undergraduates, and women from working-class backgrounds. A separate four-year study of computer science students at Carnegie Mellon University uncovered a similar persistence on the part of women who came from abroad to study at that institution (Seymour 1999: 119, 122–123; Margolis et al. 2000: 118–119).

Small, single-sex class experiences are useful for retaining women of color as science majors according to one study. Researchers looked at an introductory chemistry course with a large lecture class that offered single-sex laboratory sessions with female instructors and research assistants. At the end of the year, 69% of the women in the single-sex lab sessions planned to continue in science, compared to only half of the women in the same course who attended a coeducational enrichment program. The single-sex lab strategy made only a small difference for white women in the study: 45% who attended those sessions said they planned to continue in science, compared to 42% in the coed enrichment program. But among women of color, 87% who attended single-sex labs said they planned to continue science studies, compared to 57% of women of color in the coed program (Clewell & Ginorio 1996: 198).

By 1996, women earned 53% of undergraduate degrees in biology, 19% of physics degrees, 46% in math and statistics, 28% in computer science, and 18% in engineering.

One study found that the climate for undergraduate physics students, both female and male, can be distressingly chilly. Physics departments are remarkably homogeneous. In 1995, barely 5% of college physics instructors were African American, Hispanic or Native American (National Science Foundation 1999: 297). The lack of female students arose as an issue at a national conference of physics department chairs, and they appealed to the American Physical Society and the American Association of Physics Teachers for help. In an effort funded by the NSF, the organizations sent teams of women physicists on a series of site visits to 17 institutions between 1992 and 1995.

The teams reported some departments that were welcoming but others that were almost hostile to women. In many cases, several elements came into play. There were no female faculty, a situation experienced by 30% of women studying physics across the nation (Franz 1999: 227). In the worst cases, the few women students in the department seldom interacted with each other. The students, female and male, had little contact with the department chair, and

there were no faculty champions concerned about gender roles. The investigators cited a lack of respect for students as a group. The teams did not hear horror stories from the female students, but they were told of many small indignities.

The teams' recommendations, which went to the departments surveyed, were fairly fundamental. To departments in which the students had never even seen a female physicist, they suggested hosting women as colloquium speakers. For the sake of students of both genders, they suggested the departments establish a student lounge and provide more computers and student mailboxes so the undergraduates would feel valued. They suggested that teaching assistants discuss gender issues during training, since TAs could be quite insensitive and discouraging to undergraduate women. They suggested that abusive faculty—many departments had at least one—be removed from teaching key courses.

At one campus they visited, the California Institute of Technology, the new president took student life issues seriously. David Baltimore instituted a campus-wide study upon receipt of the team's report and made serious attempts to change the atmosphere. This kind of commitment is rare, according to Judy Franz of the American Physical Society, one of the principal investigators. On the matter of gender sensitivity, interviews with department leaders made it clear that, as Franz noted, "most chairs have not had the courage to raise the issue directly in a faculty meeting. I find that a little bit disappointing" *(Franz 1999: 232–234)*.

The importance of increased contact between undergraduate students in science and technology and professors was a strategy stressed by scholars in *Access Denied: Race, Ethnicity, and the Scientific Enterprise* *(Campbell et al. 2000)*. In this report of research presented at a 1995 conference on black, Latino and American Indian representation in technical education and careers, Reginald Wilson, a senior scholar emeritus of the American Council on Education, said minority students perform best when they have significant contact with professors, and "one of the greatest contributors to minority student academic success is the presence of minority faculty." University of Arizona mathematician William Yslas Velez urged professors to "begin to place as much emphasis on communicating mathematics as we do creating it."

Even more so than in physics, women in computer sciences abandon their studies at an alarming rate. The four-year study at Carnegie Mellon, which has one of the top computer science departments in the country, was instituted by then associate dean Allan Fisher to discover why so many young women who came to study computer science with high enthusiasm lost interest. Women tended to enter the program with less computing experience than men, but that in itself did not explain why the women left the major in higher proportions than male students. The women's relative lack of experience was not directly related to their success or failure as computer scientists. "Despite this gender gap in computing experience," the investigators reported, "we have found no correlation between prior experience and success; some of the most successful students have entered the program with very little computing experience. Yet when women students encounter difficulty with course work, these comparisons between their experience and that of their mostly male peers can become the

SPECIAL REPORT

Congresswoman Connie Morella: Educating Tomorrow's Workforce

REPRESENTATIVE CONNIE MORELLA, A MARYLAND REPUBLICAN who began her eighth term in Congress in January 2001, has been at the forefront of issues concerning education, scientific research and development, and equity for women. A former co-chair of the Congressional Caucus for Women's Issues, she has been described by the *New York Times* as "one of a dozen who have risen to prominence" in women's health advocacy.

When she chaired the Technology Subcommittee, Morella worked to foster collaborations among federal laboratories, industry and universities. A group that was created under a bill she introduced—the Commission on the Advancement of Women and Minorities in Science, Engineering and Technology Development—produced a series of recommendations in July 2000 to address the underrepresentation of women and minorities in the nation's technical workforce. "We have begun to recognize this problem," she said, "but until we give it priority on our national agenda, and until our scientific and technological workplace reflects our diversity, we are not working to our potential as a nation." She noted that by 2020, "women will comprise nearly half of our U.S. workforce, and yet today, they represent only 9% of engineers and 27% of computer programmers."

Following a recommendation of the commission, Morella offered an amendment to the National Science Education Act that established a grant program for community colleges to recruit and retain women, minority men and persons with disabilities in science and engineering programs. "Leaders in the information technology industry have recognized the potential role that community colleges play in preparing students to compete in the information age," she explained.

The kind of student targeted by such grants has been the focus of Project Futurebound in Tucson, Arizona. Undertaken by the Women in Science and Engineering Program at the Southwest Institute for Research on Women and the University of Arizona College of Engineering and Mines in partnership with Pima Community College and Tucson high schools, the program works to enroll and retain Hispanic and Native American students who would eventually earn engineering degrees at the University of Arizona. Involving the Pima student body reaches out to students who are frequently older than typical undergraduates and who have more family responsibilities and need for income.

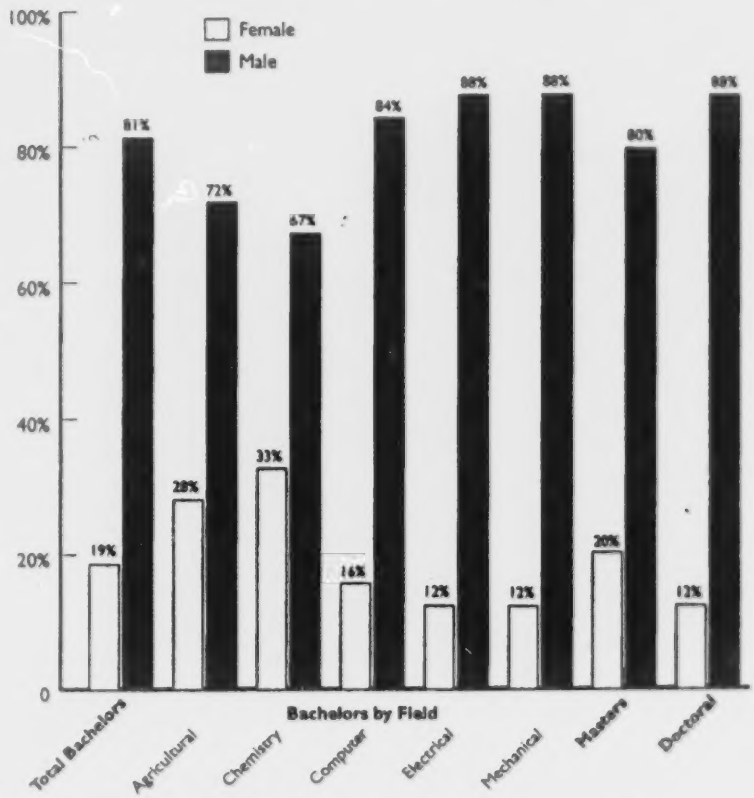
In announcing another program to train technical workers in the District of Columbia metropolitan area, Morella remarked: "Technology will be the engine of our 21st century economy, but this will require a level of technological expertise from our workforce greater than ever before." ■

kiss of death." A number of the male students in the survey, like these women, lacked what one student called a "hacker mentality." Yet these non-hacker men reported less distress than the women. While they resist "total absorption in computing, they do not question their ability to become computer scientists if they choose to do so" *(Margolis et al. 2000: 110)*.

The Carnegie Mellon study, like other research, found that the women considered computing expertise a means to an end: 44% of the women surveyed, compared to 9% of the men, "contextualize their interest in computers in other domains such as medicine, space, or the arts. These women emphasized the importance of integrating computing with people and other arenas." In the past several years, the institution dramatically raised the number of women admitted to the program and instituted reforms to help keep them there. In 1995, only 7% of the first year computing science class were women. By the fall of 2000, women constituted 40% of the entering class. (See *A Call for Future Research*, page 112 in this

A Carnegie Mellon study, like other research, found that the women consider computing expertise a means to an end: 44% of the women surveyed, compared to 9% of the men, viewed computer knowledge as supporting their ultimate goals in other domains such as medicine, space or the arts.

ENGINEERING DEGREES BY GENDER, 1998



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report.) Among the changes adopted were interdisciplinary courses that brought students of different backgrounds together to work on multifaceted problems, an undergraduate concentration in human-computer interaction, a course that lets students use their computer knowledge to work with nonprofit community groups, and the provision of multiple points of entry into computer studies. The reforms resulted in increased levels of satisfaction in students of both sexes, the more experienced computer science students as well as the less experienced *(Margolis et al. 2000: 106–107, 122; Blum, forthcoming)*.

A University of Florida study demonstrated a trend similar to that exhibited by the Carnegie Mellon women who planned to use their computer skills for people-focused careers. Looking at research-oriented science students with strong academic records, investigators found that the women were entering scientific and health fields with a focus on helping people rather than on pure research. Although both male and female juniors and seniors in the survey expressed eagerness for undergraduate research experience, women were less likely than men to be planning careers that included research. The investigators believe that such an orientation among women helps explain the rapid increase in the number of women earning M.D.s over the last 30 years compared to those earning science and engineering Ph.D.s *(Miller et al. 2000: 129, 136)*.

The achievement of affirmative action and other interventions

Though the commitment to equality in the form of affirmative action is under attack today (see *Affirmative Action: Controversy and Opportunity*, page 52 in this report), many programs have been launched to help recruit and retain women and students of color. By 1991, there were more than 300 such programs for science, mathematics and engineering in U.S. colleges and universities *(Matyas & Malcom 1991)*. Among the earlier projects is the Emerging Scholars Program, an honors level program for first year calculus students that grew out of research conducted by P. Uri Treisman at the University of California at Berkeley in the mid-1980s. Treisman noticed that African-American students, who as a group did not perform well in calculus, typically studied alone. Higher achieving Chinese students studied together and networked with friends and relatives who could help navigate the university system. He and colleague Rose Asera developed a multiethnic program targeted to both women and men. "The focus on making math public, making it clear what it takes to succeed, and that the material is hard work for everyone, necessarily benefits women," said Asera. From 1995 to 1999, she was director of research and evaluation at the Charles Dana Center for Mathematics at the University of Texas, where in 1997, women were 40% of Emerging Scholars participants. "It is no longer a private struggle," said Asera, who is currently a senior scholar at the Carnegie Foundation for the Advancement of Teaching *(University of Texas at Austin 1997)*.

While the affirmative action debate continues, many undergraduate programs rely on such techniques as mentoring to create a community that can attract and retain female science and technology students and male students of color. Other programs are expanding and remolding curriculum offerings.

Smith College launched an ambitious plan in 1999 when trustees voted to establish the Picker Program in Engineering and Technology. Building on the fact that the pedagogical elements of engineering studies—mathematics, physics, chemistry, computer science and, increasingly, biology—are strong at Smith, the college developed this new program with concentrations in computer, electrical and environmental engineering. Smith—like other top women's colleges—turns out between 25 and 30% of its graduates each year with science and math degrees, far higher than the national average for both men and women. With the new program, the college hopes to add another 5%.

Engineering is a focus for a program at the University of California at Davis. Begun in June 1997 with a grant from the Alfred P. Sloan Foundation, the Opportunities in Engineering and Science program seeks to improve the academic climate for women studying engineering, math and the physical sciences. One of its goals is to increase student awareness about the professional possibilities for women engineers and scientists by demonstrating the social relevance of work in those fields. The program consists of a distinguished lecture series, travel awards, a mentoring program, community college partnerships, and a first-year student retreat to find and nurture students, including those from previously underserved populations. Similarly, a University of Tennessee at Chattanooga program, sponsored by NSF, encourages working-class women to pursue engineering degrees *(Rayman & Stewart 1999: 63)*.

African-American women earn proportionately more science and engineering undergraduate degrees than black men. The same is true for Latinas and American Indian women compared to their male peers, in contrast to white and Asian women.

Underrepresented minority students are the focus of a program at Rutgers, the State University of New Jersey, where several academic year and summer programs serve students in the sciences, math and engineering, 40% of them women. Other programs across the country that reach out to a diverse population have similar female participation rates. In one component at Rutgers, the Biomedical Careers Program cosponsored with the Robert Wood Johnson Medical School, 90% of participants earned bachelor's degrees, and half of these went on to graduate or professional schools *(Essien 1997: 91–92)*. In a parallel approach, the Meyerhoff Scholarship Program for science and engineering students at the University of Maryland, Baltimore County, routinely sends African-American undergraduates on to elite universities for postgraduate training *(Staples 2000)*.

The opportunity to do hands-on research at the undergraduate level is one of the strategies developed in an influential pilot program begun at Dartmouth College in 1990. Such programs, now active on numerous campuses across the country, have various names—Women

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in Science and Engineering (WISE) or Women in Science (WIS)—and are connected through a national organization, Women in Engineering Programs & Advocates Network (WEPAN). Dartmouth's Women in Science Project (WISP)—founded by Carol B. Muller, then associate dean of the engineering school—uses mentoring, special spaces for women to study with tutors and an electronically distributed newsletter *(Raymon & Stewart 1999: 63)*. An element of the project, pairing undergraduate and graduate women with industrial scientists through email, grew into a national program, MentorNet, with headquarters at San Jose State University and initial funding by AT&T and Intel. In 1999, 75% of more than 200 students who participated rated the experience as highly beneficial. Mentors in the program cited such benefits as help in job recruitment and honing of communications skills *(Matis & Allyn 1999: 161–162)*. By 2001, 2000 students and more than 1900 mentors were participating *(MentorNet home page)*.

Curriculum, not climate, has been the focus of an ambitious three-year project launched by the Association of American Colleges and Universities with a grant from NSF. Operating at 10 campuses, Women and Scientific Literacy: Building Two-Way Streets seeks to integrate women's studies and science curricula. "We looked at the picture and found lots of programs designed to deal with pipeline issues and the climate in science departments, which seems to be quite chilly," said Debra Humphreys, associate project director. "But it seemed to us there were no projects that addressed, first, the content of science, and second, the pedagogical innovations that might help retain more women students."

"One must view science in context, and science in the making, rather than regarding it as a fixed body of knowledge with a certain authority behind it."

Addressing scientific literacy among women "is a matter of what is being taught, not simply a question of avoiding sexist language or calling on women and men equally," explained Karen Barad, physicist and women's studies chair at Mount Holyoke College and advisory board member of the project. She said that one must view "science in context, and science in the making, rather than regarding it as a fixed body of knowledge with a certain authority behind it." The "two-way street" of the project's title comes from the conviction that sciences need to be opened up to new perspectives about scientific knowledge at the same time that women's studies curricula and other non-science disciplines need to include more science.

As part of the program at Portland State University, a Committee on Gender and Science developed instruction modules for required freshman courses derived from experience teaching interdisciplinary courses in science and the humanities and science and the liberal arts. The materials address whether innovative curriculum change in general education classes can affect attitudes toward science among women students and attitudes toward women in science among men. At Barnard College, one of the new women's studies courses designed

by project members is an introduction to women's health throughout their lives. The course—which was designed to be inclusive, with no prerequisites—emphasizes the scientific basis of knowledge and includes discussion of the scientific method and quantitative methods *(Association of American Colleges and Universities)*.

For a group of professors at the University of Arizona, the Women and Scientific Literacy program provided an occasion to grapple with basic pedagogical issues. This group found that discussing these matters purely in terms of gender was not helpful for two reasons. It ignored the exclusion of non-white, non-elite men, and, therefore, failed to explain why science had become largely the terrain of elite, white, Euro-Americans. Also, the gender model seemed to impose a burden of "difference" on women students in a context where the tendency was already to see them as "other." It was more useful to assume that not all students learned in the same way nor were equally confident in the classroom. As a result of these conclusions, they discussed approaches with a few principles in mind: learning and teaching are hard work; the dominant strategy of intimidating students and stuffing them with "facts" is generally ineffective; and instructors continue to be learners.

The University of Arizona professors were searching primarily for a way to let their students experience their own excitement about learning, thinking and teaching across disciplinary boundaries. They wanted them to understand how such composite knowledge increases one's ability to participate and make decisions in the world. The discussions allowed the instructors to reexamine their own assumptions about how students learn, setting the groundwork for new learning environments.

Such probing efforts can lead to a fundamental reexamination of the way science and math are practiced and taught. But even that is only the beginning. "The project has opened up new intellectual pathways among the sciences, the social sciences and the humanities," noted Caryn McTighe Musil, national director of the project. "It has empowered students to ask new questions about the sciences, whether they are science majors or not" *(National Council for Research on Women 2001a)*.

RECOMMENDATIONS AND CONCLUSIONS:

- **Exercise leadership at all levels—trustees, university presidents and provosts, department heads, faculty committees and alumnae groups—to mandate gender equitable practices.** Make performance evaluations, including tenure decisions, reflect an institutional commitment to advancing women and underrepresented minority students in the sciences and engineering.

- **Allocate adequate funding within institutional budgets to ensure the success of gender equity efforts.** Press foundations, government and national organizations to provide funds for initiatives designed to advance systemic change.

- **Examine admissions practices that perpetuate discrimination; develop and implement principles of inclusion and outreach in these policies.** As court or legislative actions force many institutions to reevaluate the role of affirmative action intervention, over-reliance on test scores and Advanced Placement grades may perpetuate bias in admissions screening processes.

- **Substitute courses that invite students into the discipline for gatekeeping courses designed to weed students out at early undergraduate levels,** particularly in fields like computing, physics and engineering where young women may have been discouraged by negative stereotypes. Since students are most apt to abandon plans for a science major in their first year, develop interventions to prevent dropouts.

- ❑ **Invest in mentoring programs with role models who can demonstrate the people-helping facets of careers in the sciences and technology.** Young women who tend to view science as a means to an end are attracted to these aspects of a technical career rather than simply to science for its own sake.

- ❑ **Add research components to undergraduate study.** Give students an early introduction to science and engineering applications. Undergraduates have identified the opportunity to do research early in their academic careers as an encouragement to remain in the sciences.

- ❑ **Value undergraduate students, both female and male.** Encourage sufficient access to instructors and tools such as computers, and make the physical surroundings of science departments welcoming to undergraduates.

- ❑ **Adjust science and engineering curricula to accommodate late bloomers.** For example, design course requirements that can be completed in three rather than four years, or meld liberal arts with technical courses of study.

- ❑ **Offer interdisciplinary curricula** for students who regard science study as a means to an end, such as becoming a doctor, rather than an end unto itself.

- ❑ **Include overall scientific literacy as a primary goal of undergraduate education.** The workforce of the 21st century will need increased competence in science and technical proficiency.

PART 3 ACADEMIA—GRADUATE SCHOOL AND BEYOND

Contrary to popular perceptions that women leave academic science because of demands at home, most women scientists remain continuously employed after completing their training.

Ever greater numbers of women are committed enough to prepare for a life's work in math, science or engineering by going on to graduate school: by 1997, in the United States, women earned 41% of Ph.D.s in biology and agricultural science, 23% in math, 22% in the physical sciences, 16% in computer science and 12% in engineering *(National Science Foundation 2000: 188)*. If they choose to build academic careers at any of the nation's research institutions, they face more years of postdoctoral study before they can expect to compete for increasingly rare assistant professor slots. It is a gratifying but demanding journey for women—particularly since gender barriers still persist. Many women scientists believe that achieving equity in academia is a far more difficult challenge than making inroads as scientists and technicians in business and industry.

Gloria Hewitt is one who succeeded. Having discovered a love of numbers in high school and in a Fisk University calculus class in the 1950s, she entered a predominantly white world for the first time when she accepted a teaching assistantship at the University of Washington. She overcame obstacles of both race and gender to build a career at the University of Montana, where she moved up the ranks to become a full professor in 1972 and chair of the mathematics department in 1995. Looking back on her journey and those of her colleagues, Hewitt sees a difference in the way women and men progress in academia. Men, she believes, are assumed competent "until they mess up," but women must prove themselves at each stage before assuming positions of power. Hewitt thinks it is important to exercise that power, so she fought for and won positions on policy-making and graduate-education committees along the way *(Berczuk 1999: 26–27)*.

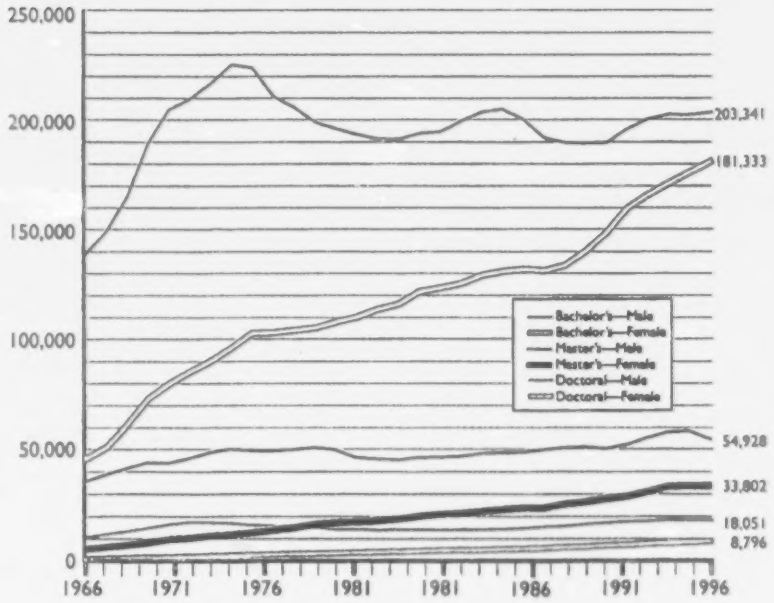
Among African-American women awarded doctorates in biology between 1975 and 1992, 75% took their undergraduate degrees at black institutions, notably two women's colleges, Spelman and Bennett.

From beginning to end, a woman's experience in graduate and postgraduate education in the sciences and math is likely to be subtly different from a man's. Women tend to come from different undergraduate atmospheres. A surprisingly large proportion of women who go on to earn doctorates in science and engineering come from liberal arts colleges, especially women's colleges, rather than from universities. For women of color, the difference is more pronounced, with historically black colleges and universities playing a major role. Among African-American women awarded doctorates in biology between 1975 and 1992, for example, 75% came from black institutions, notably two women's colleges, Spelman and Bennett *(National Science Foundation 1999: 60)*. Between 1993 and 1997, Spelman graduated 44 students who went on to earn doctorates in science and engineering, second only to Howard University among the traditionally black institutions *(National Science Foundation 2000: 40, 45)*.

While female and male graduate students often complain of a lack of interaction with and

TOTAL SCIENCE AND ENGINEERING DEGREES AWARDED BY DEGREE LEVEL AND GENDER

By 1997, women earned 41% of Ph.D.s in biology and agricultural science, 23% of math Ph.D.s, 22% in the physical sciences, 16% in computer science, and 12% of engineering doctorates in the United States.



NOTE: Psychology and social sciences are included in the science and engineering category.
COMPILED FROM: National Science Foundation (1999). *Women, Minorities, and Persons with Disabilities in Science and Engineering: 1998.* Arlington, VA, p. 255. National Science Foundation (2000). *Women, Minorities, and Persons with Disabilities in Science and Engineering: 2000.* Arlington, VA, pp. 120, 171, 180, 186, 187.

mentoring from faculty members, the absence seems to be experienced more acutely among women. In a study of physics departments across the country, 52% of the men but only 38% of the women said they thought it was easy to discuss ideas with faculty *(Franz 1999: 230–231)*. A project at the University of Arizona—Breaking the Silences: A Faculty-Student Action Project for Graduate Women in Science and Mathematics—lends insight into that phenomenon. Banu Subramaniam, the project's principal investigator, looked at four departments: math, ecology and evolutionary biology, molecular and cellular biology, and chemistry. The need for greater communication between faculty and students was the most persistent issue raised by the students. The students called for greater recourse if they found themselves working with unsupportive advisors or in unfriendly labs.

A considerable gap existed between what the University of Arizona graduate students were experiencing and the perceptions of the faculty. The students tended to describe problems in terms of power relationships—the politics of a situation in a lab, for example. The faculty tended to interpret the same difficulties in psychological terms—perhaps citing a student's reaction to academic pressure. A small group of students and faculty from the four departments met to discuss the issues the survey identified. This phase of the project was gratifying for those involved since it demonstrated the possibility of productive and candid exchange between faculty and students *(Subramaniam 1997)*.

BEST COPY AVAILABLE

Richard Tapia, a mathematics professor at Rice University, spoke of his experience mentoring women and students of color at a National Academy of Sciences symposium in the fall of 2000. He emphasized the necessity of meeting the different needs of each student and brought a message to the group from his women graduate students:

> Mentoring is not something that you do from two to three on Monday, Wednesday, and Friday. It is something that you do at all times and in particular when the need arises and in the problem areas. We are not aware of the fact that we are being mentored or that we need mentoring. It is a part of our everyday experience and our professional training. Some faculty are terrible at mentoring. Not all faculty should mentor *(Tapia 2000: 15)*.

In a chapter on the graduate experience in *The Equity Equation*, the authors point out that, however much scientists like to see themselves as objective practitioners, science and engineering departments do not inhabit an objective intellectual realm. They are shaped by assumptions about the research to be done, by underlying motivations and by expectations that "can in turn alienate, disqualify, or devalue people whose background and experience are different." They suggest two overlapping approaches to increase women's participation: look at institutions as they are and see how the relative absence of women stems from current practices; and examine women's lives and determine how those realities are or are not consistent with features of graduate education. The goal is to develop institutions "that don't just accommodate women—almost as a concession—but that incorporate the experiences and goals of women as well as men." The authors cited many studies showing that women feel isolated or even harassed, ridiculed, or humiliated in the more male dominated fields of study *(Hollenshead et al. 1996: 128–129, 134–135)*.

Such feelings of discomfort can stay with a graduate student into postdoctoral training. Describing the atmosphere in a biotechnology lab at Brown University, Diane Hoffman-Kim said that the women were put off by combative conversational styles and resented a climate of individualism that seemed to prevail. One woman colleague gave the example of a male student telling her to figure out a particular technique for herself after the lab advisor had suggested she ask him for help. "Being assimilated into the prevailing culture of science is an integrative process for men, in which they have to adapt in some ways, but they face no challenge to their identity as men in our society," she observed. "For many women, however, the experience of entering and assimilating into the scientific culture challenges their core sense of self" *(Hoffman-Kim 1999: 107–108)*.

This predicament of women postdoctoral students was reiterated by John Dowling, a Harvard biologist and member of the National Academy of Science. He noted that for years in his field, Harvard has achieved gender equality in the number of undergraduates and graduate students, but by the time postdoctoral fellowship applications came in, the number of women applicants significantly decreased. "They love science, and they've very much enjoyed their graduate training," he said of these young women. "They've usually accomplished a significant

piece of research while in graduate school. But they don't want to continue to become involved in what they often describe as the 'rat race' of applying for and gaining grants, or competing for job promotions and, eventually, tenure. This is not a lifestyle to which they are attracted." Dowling talked to many of these women about their options at this juncture. "I think all have remained connected with science—in industry or in science teaching at the secondary school level or in science publishing," he said. "But we are losing them from the academy—from our research colleges and universities—and this is unfortunate, for science and for academe" *(Dowling 1999: 94)*.

In all science and technology fields, the proportion of women assistant professors has increased from just under 10% in 1973 to over 30% in 1995, and the proportion of women associate professors grew from just over 5% to almost 20%; but women full professors, about 3% in 1973, had not yet reached 10% in 1995, even though the percentage of science Ph.D.s awarded to women has been at or above 25% for three decades.

A constricted job market and tighter funding face both female and male scientists at the postdoctoral level and above. A major concern, as Harvard chemist Dudley Herschbach and others observed, is the expansion of the time it takes a graduate student to complete a Ph.D. Six or seven years has become the norm, and postdoctoral experience is expected for those who seek faculty positions. As a result, assistant professors start out several years older than was usual some years ago. "What should have been an invigorating, adventurous jaunt on the way to an independent position has, for far too many, stretched into a grueling marathon," he said *(Herschbach 1999: 71)*. This is likely to be the experience of women more than men, since male scientists tend to earn Ph.D.s faster: 83% of men, but only 74% of women, earn their Ph.D.s in science and engineering within 15 years of entering college. Only 64% of women with disabilities manage to earn their science Ph.D.s within that time compared to 76% of men with disabilities *(National Science Foundation 1999: 94–95)*.

A young scientist's independence is undermined by the economic structure of research institutions. Funding goes to the project, not the person, leaving senior professors in charge of hiring and supervising the younger lab assistants—a situation that would be eased if more postdoctoral fellowships went directly to the young scholar. Winning such a stipend, said Herschbach, "profoundly influences a student's outlook and approach to research work; they are certified as a national resource rather than a hired hand" at the mercy of the grant recipient. In the last 15 years, because of the high cost of supporting assistant professors until they

can bring in their own grants, the number of postdoctoral workers has increased and the number of assistant professors has declined. At the major research institutions, in chemistry, 10% rather than 25% or more of faculty are assistant professors. This syndrome, along with the recent abolition of mandatory retirement, "is accelerating the graying—and balding—of science faculties," explained Herschbach. He suggests a remedy of block grants to research centers to cover start-up costs for beginning professors *(Herschbach 1999: 72)*.

Daryl E. Chubin of the National Action Council for Minorities in Engineering agrees that the current funding system is not the optimal way to support the training of the nation's scientists. "The way we award money," he said, "means that the locus of control for human resource development has been placed in the hands of professors. In many cases these are particularly brilliant professors whose concern is to advance their careers and a research program at the expense of their post-docs, their pre-docs, their undergraduate students, and probably their families in some cases as well. I hate to think that, regardless of the brilliant science that may be produced from this federal investment, we are undercutting our ability to compete globally" *(Selby 1999a: 238)*.

Others point out that funding for academic science, from whatever source, needs to be awarded with careful consideration of the involvement of women and minority men from the beginning of a project. An initial proposal by the University of Southern California, for example, on how to spend a $20 million donation to advance women in science was drafted with no input from women *(Zernike 2001)*. Jane Butler Kahle, science education professor at the University of Miami in Oxford, Ohio, said that what worried her after two decades of involvement with funding issues "is when a foundation demands attention to equity, but allows that attention to be in the proposal at a superficial level. Everybody has the magic words, 'I will seek out minorities and women as staff and participants.' But you don't see any lines in the budget suggesting that they have a recruitment strategy. It's possible to make those requirements more stringent" *(National Council for Research on Women: 1997)*.

In science, math and engineering departments, women tend to teach at more junior levels than men, fewer are tenured and the salary gap widens with age. A higher proportion of female than male scientists teach at two-year colleges.

For science and math faculty, the gaps between women and men increase in important ways the higher the position. Women tend to teach at lower levels than men, and fewer are tenured. The salary gap widens with age. A higher proportion of female than male scientists teach at two-year colleges *(National Science Foundation 2000: 229)*. According to a study of Harvard Ph.D.s, the prevailing assumption that the scarcity of women on university faculties is the result of their leaving to raise their families is simply wrong. Most women scientists remain

continuously employed after completing their training, and the proportion of women with doctoral degrees who seek academic positions is slightly higher than that of men *(Sonnert & Holton 1995)*. Sociologist Mary Frank Fox, in *The Equity Equation*, cites studies showing that "while the perception may persist that marriage and motherhood govern women's performance in science, the data indicate otherwise." She wrote that single and childless women perform similarly to women with husbands and children. She noted, however, that the data only describe women "with careers in science, who have survived a demanding process of scrutiny, selection, and evaluation. Family demands may take their toll along the way" *(Fox 1996: 280)*.

A study by Joan A. Steitz, a Yale molecular biologist, suggests that family responsibilities may penalize women in subtle ways. A typical strategy for extracting more money or more recognition from a university is for a scientist to threaten to take his or her research elsewhere, but women tend to be less able to uproot themselves. Steitz looked at how often members of the National Academy of Sciences moved in their careers. About 60% of the women had never relocated, compared to about 40% of the men *(Zernike 2001)*.

The quest of women scientists to attain parity in faculties today—in the absence of aggressive measures—is still a game of catch-up, with a resulting two steps forward, one step back pattern. Dudley Herschbach first considered the problem in the early 1970s as part of a Harvard committee to improve the numbers of faculty women throughout the university. Some reforms were instituted, including allowing part-time appointments to any professorial rank and giving a non-tenured professor who becomes pregnant a year's extension of her appointment. Women's appointments increased. In the late 1990s, women received about 25% of tenured appointments at Harvard. This was a reasonable portion of the pool available when measured by the fraction of Ph.D.s earned by women 15 years before. But the proportion of tenured women in the faculty did not increase much above 11%, largely because new appointees replaced retiring women who had gained their own tenure rather late in their careers *(Herschbach 1999: 68)*.

A typical strategy for advancement is for a scientist to threaten to take his or her research elsewhere, but women tend to be less able to uproot themselves.

An analysis of the national data on women professors in science and engineering fields, including the social sciences, was presented to the 2000 National Academy of Sciences symposium by M.R.C. Greenwood, chancellor of the University of California, Santa Cruz. She said that the number of women at assistant and associate professor levels approaches the proportion one might expect based on past Ph.D. award rates. The percentage of women assistant professors has increased from just under 10% in 1973 to over 30% in 1995, and the proportion of women associate professors grew from just over 5% to almost 20%. But for full

professors, the rate of increase "does not keep pace with expectations." In 1973, the participation rate of women as full professors was 2 to 3%, and by 1995, it had not yet reached 10% even though the percentage of science Ph.D.s awarded to women has been at or above 25% since 1970 or before. Given that much of the growth of women's share of full professor positions in science and engineering "can be attributed to the increases in biological and social sciences, it appears that we may be losing a significant number of women before they reach this level," she concluded. "The numbers have actually dropped in fields such as engineering, and the steady growth in physical and mathematical sciences has not yet brought the numbers of women full professors to the 5% mark" *(Greenwood 2000: 69)*.

An institution examines itself

When MIT released a recent study on sex discrimination in the faculty, the announcement created a national stir, perhaps because it was the first time that subtle forms of discrimination were acknowledged publicly by top university officials. "I have always believed that contemporary gender discrimination within universities is part reality and part perception," commented Charles M. Vest, MIT president. "True, but I now understand that reality is by far the greater part of the balance." In addition to hiring and promotion statistics, the study—conducted by a group of female MIT professors led by biologist Nancy Hopkins—analyzed such factors as awards, inclusion and reception on important committees, and allocation of valuable resources, for example, laboratory space.

The percentage of women on MIT's School of Science faculty remained virtually unchanged at 8% for 20 years. Even in biology, where, in 1994, undergraduate women outnumbered the men, there were only seven women faculty to 42 men. Some faculty men were operating under more than one antiquated assumption, including the idea that a single woman was less in need of a raise than a "family man," or, conversely, that it was implausible that a woman with young children could work hard enough to fill a particular position. In "this post-Civil Rights era," the report concluded, "discrimination consists of a pattern of powerful but unrecognized assumptions and attitudes that work systematically against women faculty even in the light of obvious goodwill" *(Bix 2000: 42)*.

The record of women at MIT goes back to 1871, when Ellen Swallow was admitted as a "special student" in chemistry and went on to earn her degree in 1873. Her career at MIT is instructive. She made the mistake, argued environmentalist H. Patricia Hynes of Boston University, of moving across department boundaries, risking treatment as a dilettante. She distinguished herself as a water and industrial chemist, metallurgist, mineralogist, nutritionist and engineer. She taught an interdisciplinary curriculum that evolved into ecology. One biographer suggested that her science—integrating the chemistry of soil, air and water, biology, and study of the human environment—was seen as "an unpedigreed, mixed breed by the specialized science aristocracy" *(Hynes 2000: 159)*.

Although Swallow established the MIT Women's Laboratory to train students so that they could enter regular courses, it was accepted that even their own champions would not treat

women as men's equal. Florence Stiles, drafted from the library staff in 1923 to advise women students, said, after 25 years of advocacy, "Women in general do not make acceptable engineers, although they have the intellectual ability to be proficient academically. However, they are acceptable in the so-called 'white apron' jobs in foods and hospitals."

According to biologist Cecily Cannan Selby, she and other MIT women graduates felt encouraged in their work by particular professors in the 1950s *(National Council for Research on Women 2001b)*. In the mid-60s, when psychologist Bruno Bettelheim told an MIT symposium that "women want first and foremost to be womanly companions of men and to be mothers," he drew an angry audience response. Despite a burst of activism for gender equity in the 1970s, according to the recent MIT report, perceived advances were misleading. "Marginalization increases as women progress through their careers at MIT," according to the report, and "this pattern repeats itself in successive generations.... Each generation of young women, including those who are currently senior faculty, began by believing that gender discrimination was 'solved' in the previous generation and would not touch them. Gradually however, their eyes were opened to the realization that the playing field is not level after all, and that they had paid a high price both personally and professionally."

"Discrimination consists of a pattern of powerful but unrecognized assumptions and attitudes that work systematically against women faculty even in the light of obvious goodwill."

Following the report, the administration moved quickly to increase the numbers of women on the faculty, and women moved past 10% of School of Science faculty for the first time *(Bix 2000: 23–26, 32, 42)*. Mildred Dresselhaus, MIT electrical engineering and physics professor, reported on the changes at the 2000 National Academy of Sciences symposium. She said adjustments made largely under the leadership of the dean of science "led to increased (documented) productivity of the women faculty, so that the small investments made by the dean led to significant benefits to the individuals and to MIT as a whole" *(Dresselhaus 2000: 56)*. Such an increase in productivity indirectly countered some critics of the original study who suggested that the MIT women, for example, did not produce as many cited publications as their male colleagues and that was why they lagged behind in promotions and other benefits. Commenting on the study, Shirley Malcom of the American Association for the Advancement of Science wondered how many other science and engineering institutions of academia, industry or government would be willing to undertake or make public such self-scrutiny. She noted that both old disciplines and new had their problems—physics departments found it difficult to increase women's entry, and computer sciences found it impossible to maintain women's participation at the level it once was *(Malcom 1999: 1271)*.

On January 29, 2001, MIT hosted a dialogue on equitable treatment of women science and engineering faculty that brought together presidents, chancellors, provosts and 25

women professors of nine top research universities. The group recognized that deep institutional change is required to achieve equity. Representatives of California Institute of Technology, MIT, the University of Michigan, Princeton, Stanford, Yale, the University of California at Berkeley, Harvard and the University of Pennsylvania agreed to a short statement with three goals: a faculty whose diversity reflects that of the students; equity for and full participation by women faculty guaranteed by data analysis involving senior women faculty; and "a profession and institutions in which individuals with family responsibilities are not disadvantaged." The group agreed to reconvene to share initiatives undertaken and stated: "We recognize that this challenge will require significant review of, and potentially significant change in, the procedures within each university, and the scientific and engineering establishment as a whole" *(Campbell & Halber 2001)*.

If women faculty are to reach parity with men, much ground remains to be covered at these universities. The MIT dialogue, precipitated by the MIT study, came two years after an influential conference, Women in Research Universities: The Next Quarter Century, held at Harvard University and Radcliffe College in November 1998. The organizer of that meeting, chemist Lilli Hornig, pointed out after the MIT dialogue that in the nine universities represented, women faculty in chemistry make up a total of 7% of full professors, 16% of associate professors, and 14% of assistant professors, compared to 31% of recent women Ph.D.s *(Lawler 2000: 806)*.

Following the MIT meeting, other institutions are taking up the challenge of improving sex equity in the treatment of faculty. The University of Arizona recently launched the Millennium Project to study the work life of all faculty in the university's 15 schools, including gender inequities in laboratory space, research funds and salaries. The university said the study would serve as a national model for analyzing and improving the status of women in higher education *(White 2001)*.

Considering daily life in science

There is no simple programmatic way to address the complicated interactions that contribute to gender inequity at graduate and faculty levels in science and engineering. One program that has tackled a range of the issues involved is the Clare Boothe Luce Professorships, established in 1986 to support women scientists and engineers early in their careers. The program creates tenure-track positions for women at a variety of colleges and institutions across the country and funds them for the first five years. The appointments must be made from outside an institution's existing faculty. A particularly appealing part of the plan is the additional 20% of salary provided for professional expenses such as travel and manuscript preparation but which can also be used for childcare. By 1999, a survey showed that every one of the then more than 70 Clare Boothe Luce Professors had gained tenure.

Professors from the program took stock of themselves and what they had learned at a gathering during the 1998 New York Academy of Sciences conference on women in science and engineering. All felt that the program lent prestige to their institutions, though some experienced a degree of discomfort at being hired under a women-only award. They dis-

SPECIAL REPORT Interventions to Advance Women on Science Faculties in Europe and Canada

Adapted from **European Technology Assessment Network (ETAN)** *Report on Women and Science*, 2000, 25–26, 41

- In the United Kingdom, the Dorothy Hodgkin Fellowship offers women scientists a salary for four years, an annual research expenses grant and the possibility of moving between part-time and full-time appointments to help match work and family commitments. As with the Clare Booth Luce Professorships in the United States, part of the funding can be used for "family support," to cover costs of child care during a conference, for example. The program offers career advice, mentoring and networking opportunities. Although not strictly a women-only program, women have been especially encouraged to apply, and 45 of 48 awards made between 1995 and 1999 went to female scientists.
- In 1999, the Hermann von Helmholtz Association of German Research Centres established a framework in which its institutions can choose to create up to 100 additional positions from their running budgets for, mainly, women in science. The Research Centre Jülich used such funds to create a tenure track program for three female scientists each year. The Berlin Senate approved a program to support 60 of these faculty positions for women.
- In the Netherlands, the Organization for Scientific Research launched a program for female assistant professors to apply for 30 earmarked research grants. With the aim of enlarging the pool from which professors are chosen, successful grant applicants are promoted to associate professor.
- In Canada, the University Faculty Awards program annually funds 15 multi-year grants to encourage universities to appoint women in natural science and engineering to tenure-track positions. The awards include a guaranteed minimum research grant. In addition, five chairs were established for women in engineering.
- In Sweden and Germany, programs have created higher level positions for women. The Swedish program, following a proposal by then education minister Carl Tham, established 31 full professorships in 1995. Men could apply but were chosen only if there were no suitable female candidates. One of the new female appointees at the Royal Institute of Technology in Stockholm became vice chancellor in 1998. Drawing on private funding sources, Germany's Max Planck Society for the Advancement of Science provides nine, five-year associate professor level positions to exceptional women scientists. The program was designed to double the number of women occupying such posts. ■

cussed the added burden of being a token female on committees and the time-consuming work of advising the women students. Similar reservations were expressed by Swedish physicists and chemists who held Carl Tham professorships, a program like the Luce awards established in 1995 by the Swedish minister of education. (See *Interventions to Advance Women on Science Faculties in Europe and Canada*, page 76 in this report.) Some of the Swedish women were reluctant to be associated with the affirmative action initiative because they worried that it was dangerous to point out any differences between men and women scientists *(Benckert & Staberg 2000: 87, 98)*.

In a survey of academic women scientists and engineers who received NSF professional opportunity awards, 62% said balancing work and family responsibilities was a great concern in 1997; by 1999, an even greater 77% cited such conflicts as a significant challenge.

The Luce professors at the New York gathering agreed that the award, while not a panacea, was definitely a positive support. Shenda M. Baker, a chemist at Harvey Mudd College, described her struggle with work and family issues. "I often feel that I am either spending too much time at work and neglecting my children or spending too much time with my children and neglecting my research or students." She could strike a good balance with the help of the Luce professional funds, which allowed her to hire a nanny when her children were young. Her husband shares childcare responsibilities, but "this conflicting sense of duty is persistent nonetheless," she said. She was pregnant before her institution had a written parental leave policy, and though she managed to negotiate a possible leave, she was glad she did not need to take it and set what might have been seen as a bad precedent for other women. Now the college has a formal policy, "but I am convinced that unless some men also take advantage of the program, this leave will still be considered only a woman's issue" *(Baker 1999: 215–216)*. Others have noted that women who do take maternity leave often feel pressure to return to the classroom within weeks of giving birth.

A recent study that relied on in-depth interviews to explore the intersections of family life and productivity for scientists documented this resistance to change by academic institutions. The research uncovered significant conflict, particularly for the women who responded, typically, by "carefully wrapping family life around the demands of scientific careers. Rarely, if ever, are they successful in modifying the dimensions of their scientific careers to fit family needs." The study noted that universities were even slower than private industries to adopt practices like shared jobs or generous maternity leaves *(Grant et al. 2000: 63, 83)*.

Sue V. Rosser, dean of Ivan Allen College at the Georgia Institute of Technology, surveyed academic women scientists and engineers who received NSF Professional Opportunities for Women

in Research and Education (POWRE) awards in 1997, 1998, and 1999 (see *Introduction*, page 25, in this report), asking them, among other questions, about the most significant challenges they face as they plan their careers. Balancing work and family responsibilities, a great concern among 62% of the respondents in 1997, was cited by an even greater 77% of the women in 1999. They registered less concern in 1999 about gaining credibility from peers and administrators: 17% cited that as a significant issue compared to 22% in 1997. More cited affirmative action backlash and discrimination concerns in 1999: 12% compared to 6% in 1997 *(Rosser & Zieseniss 2000)*.

Another Luce professor, biologist Mary S. Erskine of Boston University, found the program particularly helpful because hers is a dual biologist marriage, which is fairly common for a women scientist but often creates difficulties because of the limited number of academic positions in one area in a given field. The Luce professorship, which created a new position, came at a critical time for her. It also brought prestige—for example, membership on several substantive university-wide committees. It gave her the confidence to do what she had to do to advance her career, whether it was expressing opinions at faculty meetings or requesting an early tenure decision. She cautioned that this kind of early career support might be regarded as a sufficient means to counter gender bias, but it does not eliminate the glass ceiling *(Erskine 1999: 221–223)*.

Rutgers physicist Karin Rabe said the Luce program and the AT&T Graduate Fellowship Program that supported her when she was earning her doctorate at MIT were both important in addressing the problem of isolation that affects women in science. "Although I never needed this kind of help," she said, she had heard of AT&T women fellows "who actually had to do their Ph.D. research at Bell Labs because of the way they were treated in the physics departments where they were graduate students" *(Erskine 1999: 224)*. The AT&T fellowships, which began in 1975 and are open to women and underrepresented minority men, provide all education expenses during the school year and support for attending scientific conferences. They pair graduate students with experienced scientists as mentors. One of the program's positive outcomes is that participants, on average, earn Ph.D.s six months to a year faster than the national norm *(Mattis & Allyn 1999: 163–164)*.

Within the department of electrical engineering and computer science at the University of California at Berkeley, activity by women graduate students has been essential to stimulate institutional change, according to Sheila M. Humphreys, academic coordinator for student matters in the department. Starting in the late 1970s, successive generations of women graduate students have "worked to initiate programs and also to develop policies to increase diversity in engineering" by forming "critical partnerships with faculty and deans to gain approval for admissions and recruitment programs. They have regularly conducted their own institutional research, gathering data to support the need for change. The university has responded in a reactive rather than proactive fashion." She noted that Berkeley has a long history of student activism and that, "in an environment in which academic departments prize their autonomy," pressure by students working with their professors is likely to be more successful than "top-down" initiatives mandated by the administration *(Humphreys 1995)*.

The construction of models for institutional change in order to advance women in aca-

demic science and engineering careers is the goal of a new NSF ADVANCE program of awards. The $19 million pilot program in 2001 offers three types of awards: Fellow Awards to enable promising individuals to establish or reestablish full-time research and education careers; Institutional Transformation Awards to promote the increased participation and advancement of women; and Leadership Awards to recognize the work of outstanding organizations or individuals and to enable them to sustain, intensify and initiate new activity *(National Science Foundation 2001)*. Program director Alice Hogan says the significance of ADVANCE lies in its focus on systemic change, whereas previous NSF programs have encouraged individual women scientists and engineers or intervened at critical stages in their careers. Through this program, targeted money will go toward transforming institutions "so that women can thrive rather than just grit their teeth to get through" *(National Council for Research on Women 2001c)*.

Cultural critiques and women's place in science

In many discussions of the need for higher numbers of women scientists and engineers, there has been some agreement that at least a 15% critical mass of women in any one department or lab or workplace would be necessary to begin to force the institution to improve conditions for women. Biologist Diane Hoffman-Kim, from her vantage point as a postdoctoral student at Brown University, believes that such a definition for critical mass falls far short of what is really needed for changing the workplace culture *(Hoffman-Kim 1999: 108)*. Harvard chemist Dudley Herschbach, while recognizing the complexities, remains optimistic. "Even long overdue institutional changes can occur quickly when a new consensus emerges," he said *(Herschbach 1999: 73)*.

What will happen when women achieve sufficient "mass" in science and engineering fields to influence the culture? As zoologist and feminist scholar Sue Rosser queries, will "women's specific interests, life experiences, and perspectives lead them to ask new questions, take different approaches, and find alternative interpretations leading to new theories and conclusions drawn from data?" *(Rosser 2000a: 8)*. In the late 1960s, historians and philosophers of science such as Thomas Kuhn challenged the view of sciences as "objective," arguing that work in science is driven by assumptions and ideas that reflect the values and beliefs of the culture within which they arise *(Kuhn 1996)*. In the 1970s, feminists brought to the discussion a consideration of the absence of women's lives and experiences. Feminist and cultural scholars opened a continuing debate about the nature of knowledge, emphasizing its grounding in particular historical, social and cultural contexts.

In 1982, Evelyn Fox Keller, a professor of history and the philosophy of science at MIT, argued that male bias was woven throughout the "foundations of scientific thought." Her critique was designed to produce not a different science but a more open one, capable of realizing "latent potentialities" that were excluded by such a bias *(Keller 1982)*. Going further, philosopher Sandra Harding argued that in science, as in other fields of knowledge, the nature of "truth" depends on the position and perspective—the standpoint—of the observers. According to Harding and other feminist scholars, knowledge, including science, is socially constructed and shaped at least in some ways by human purposes and values *(Haraway 1991, Harding*

1991, Rosser 1997, Rosser 2000b). To avoid flaws and biases in seeking and producing knowledge, they argue that consideration must be given to the ways gender, race, ethnicity, class and even global power relations intersect to shape perspectives. In addressing her critics, Harding points out that this approach "does not reject science or its methods [or] rationality"; rather it strengthens and expands science *(Harding 2001: 512)*. Harding's perspective leads her to encompass in her analysis critiques of science that emanate from the lives and views of the natural, physical world of women in southern continents, whose experiences have been excluded from dominant northern conceptual frameworks *(Harding 1998)*. (See *International Efforts Through Beijing+5*, page 24 in this report.)

"Can the scientific community of which we are all members nurture and develop a sense of cooperation and collaboration in a culture of competition?"

Sue Rosser uses feminist analysis to examine "how women—as scientists, feminists, consumers, policy makers, mothers, and global citizens—may affect and be affected by bio- and reproductive technologies" *(Rosser 2000b: 4)*. She points out that the multi-billion dollar Human Genome Project, with its focus on genes, suggests to the lay public that most disease is biologically and genetically determined. This perspective has led to the concentration of research dollars on high tech solutions developed by medical research rather than on studies of the environmental causes of disease and on public health strategies. Rosser further argues that the research emphasis on the genetic causes of breast cancer, when research has shown that only 5 to 10% of breast cancer is inherited, dangerously diverts attention from social, behavioral and environmental factors that need to be examined *(Rosser 2000b: 30–34)*. Significantly, such feminist critics of science as Sue Rosser, Sandra Harding, and Donna Hughes have had the opportunity to develop their analyses in interdisciplinary women's studies departments.

Despite the cultural and social critiques of feminist scholars, Anne Fausto-Sterling, a biologist at Brown University, observed that feminist and other perspectives had scarcely ruffled the sciences, which continued to view themselves as following objective modes of inquiry, uniquely suited to the pursuit of knowledge *(Fausto-Sterling 1992: 336–349)*. Her perception that not only did science have to open itself to new perspectives but that women's studies curricula had to deal more with science became the impetus for the Association of American Colleges and Universities' Women and Scientific Literacy project (see Part II on *The Undergraduate Experience*, page 62). Meanwhile, the debate continues over the extent to which there is anything that could be described as feminist or women's science.

Evidence exists that there is at least a difference of style in the way most men and most

women tend to approach scientific work. As Paula Rayman, director of the Radcliffe Public Policy Center, put it, the problem and solution of women's place in scientific inquiry may lie in the institution of science itself. "Given that science, like most elements of our culture, is socially constructed, the current dilemmas regarding women in science may well be the result of the inability of science, as currently constructed, to accomplish [certain] goals.... A key issue in women's participation in science is whether the scientific community of which we are all members can nurture and develop a sense of cooperation and collaboration in a culture of competition" *(Rayman & Stewart 1999: 62, 64)*.

Stylistic differences were at the heart of findings by two Harvard physicists, Gerald Holton and Gerhard Sonnert. Their 1995 Project Access study at Harvard showed that, "on the average there were differences between men and women in what they meant by 'good science,'" as Holton explained. "Women in our sample, on the whole, tended to uphold, to a statistically significant degree, what might be called the traditional standards of good science—the pursuit of fundamentals, with care, with objectivity, with replicability. They tend to shun a more risky way of doing science, perhaps... in line with the general observation that relative newcomers to a field feel watched critically, as if under a microscope" *(Holton 1999: 85)*.

Sonnert noted particular behavioral characteristics of a majority of the women scientists in their sample. They were perceived as less aggressive, combative and self-promoting in the pursuit of career success. They were more likely to choose less crowded "niche" fields. The women in their sample were more likely than the men to mention comprehensiveness when asked about the characteristics of good science. The men brought up creativity more often. He posited that this kind of difference could account for the fact that women scientists tend to publish less often than men, as well as the corresponding fact that women's works, once published, tend to be cited more often *(Sonnert 1999: 46)*.

Mary Erskine, the Boston University biologist and Clare Boothe Luce professor, offered a hint that a female scientific style may be evolving. In contrast to earlier generations, she said, "the newest generation of women scientists has a sense of entitlement to a place in academic science.... One newer and enlightened aspect of this outlook is that it is considered important and valid for a woman to devote energies to developing her career as well as to do science" *(Erskine 1999: 219–220)*.

For the New York Academy of Sciences conference, historian Sheila Tobias offered this summation of a panel discussion on cultural differences in scientific work: "The deepest of all the questions the panel did not, I think, agree on is whether continued progress for women in science is inevitable. Can we relax some of our vigilance and our activism on the grounds that the 15% critical mass is being achieved in field after field, or is there some new and unanticipated barrier ahead? The most intractable barrier—the one that even a critical mass may not be able to dislodge—may be the traditional *manliness* of the scientific enterprise (to use the language of the feminist post-modernist critique), the single-mindedness that seems to be required, the competitiveness that seems to characterize research activity in science, the cost to families" *(Tobias 1999: 77)*.

RECOMMENDATIONS AND CONCLUSIONS:

- **Encourage institutional self-examination and analysis of personal, structural, organizational and field-wide assumptions and practices that have an impact on women at all levels.** Successful changes in climate and programs to enhance opportunities for women and enable their success have resulted from collaborative efforts between organized groups of students and responsive professors, department chairs and administrators.

- **Provide the necessary senior-level institutional leadership to guarantee success of programs to restructure graduate and postgraduate education by including more gender equitable policies and practices.** Successful institutional change at Carnegie Mellon, Rensselaer and MIT all resulted from commitments to change made by senior leaders.

- **Insure visibility for women professors as role models in graduate science and engineering departments by appointing them to influential committees both within departments and university wide.** Reward professors who spend time on curriculum reform, mentoring activities and other efforts to include women of all races and underrepresented minority men.

- **Provide responsive and appropriate mentoring for women graduate students, instructors, researchers and assistant professors at the beginning of their careers.** Women graduate students in science and engineering report that successful mentors do not see their role as a part-time responsibility but are regularly available to students in various settings.

- **Look to liberal arts and women's colleges and traditionally African-American undergraduate institutions to recruit promising students for graduate science and engineering departments.** Women Ph.D.s in science tend to come from liberal arts institutions more often than their male colleagues. Examine the factors that make these settings effective incubators for women scientists and engineers.

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- **Address lifestyle and work and family issues for women, and men. Women often bring different styles, perspectives and expectations to their work as scientists.** The increasingly long graduate, postgraduate and early professional process for academic scientists has an effect on both women and men but seems a greater factor in discouraging women. The need to balance one's private and work life is a major issue for women and men beginning their academic careers in the sciences and technology.

- **Rethink the current funding structure at research institutions. Women, and men, at assistant professor levels need to be supported and valued as researchers for their contributions to the institution.** Current funding often goes to the project, and therefore to the senior faculty, with the result that those at the beginning of their careers are seen as mere adjuncts to senior staff and grant holders. Hold senior faculty accountable for quality and equitable training of those who work with them, and increase grants that go directly to promising postdoctoral fellows and graduate students, both for research and teaching positions. Programs such as the Clare Boothe Luce Professorships have successfully jump-started women's careers by offering early tenure-track teaching opportunities with funding support.

- **Continue to support such alternative settings as women's studies departments, where feminist scientists and scholars can offer critiques of the current structures of scientific work and offer alternative visions of the future.** Through conferences and multidisciplinary seminars, encourage the cross-fertilization of scientific and technical inquiry with feminist and other perspectives.

PART 4 BUSINESS AND INDUSTRY

Women constitute 45% of the workforce in the United States, but hold only 12% of science and engineering jobs in business and industry.

A woman in science or engineering may well look at the difficulties of building an academic career and decide the private sector offers a more level playing field in terms of gender equity. One corporate executive argues that the profit motive can be a powerful affirmative action tool, albeit not one that operates automatically. "The matter of inclusion has to do with economics," said Roberta W. Gutman, former vice president and director of global diversity at Motorola and current executive director of the Motorola Foundation. "That's why I believe we are going to crack the code first in industry.... We are seeing the consequences of not cracking it before the rest of the institutions."

She noted that, within the last decade, the number of women vice presidents at her company grew from just two to 43. "Women have been tremendous contributors to corporate America when we allowed them to do so," she said. "Until very recently—I'd say in the last ten years—corporate America allowed only enough women in management to avoid problems with the government" *(Goldberg 1999: 12)*.

Among computer and mathematical scientists in business and industry, the salary gap between women and men increases with age: the 1995 median salary for women in their 20s with bachelor's degrees was $35,000 compared to $38,000 for men; the median salary for such female workers in their 40s was $48,000 compared to $57,000 for men.

Unlike engineers and MBAs, a scientist coming out of training and trying to decide between an academic career or industry may have little information on the possibilities of research outside the university. In a recent study by Catalyst, a research and advisory organization that monitors gender issues in the workplace, only one of 30 women scientists it surveyed at Fortune 500 companies said she was actively encouraged by her academic advisors to pursue a career in industry. Some of those surveyed said that looking outside the academy was seen by their classmates as "selling out" *(Catalyst 1999: 11)*.

One-third of the women mentioned the negative aspects of an academic environment as reasons to pursue commercial opportunities. A former professor and current biotech CEO said, "I had this sense that I had gone into research in order to contribute. And I spent this large period of time writing grants, writing papers, making sure the dean didn't take away my space, and I had forgotten the mission...I remember thinking if I'm so smart, why haven't I cured anybody of anything yet."

One possible solution to a science student's lack of exposure to career opportunities in industry has been the development of new professional master's degrees. Funding begun in 1997 by the Alfred P. Sloan Foundation encourages such "science plus" degree programs to

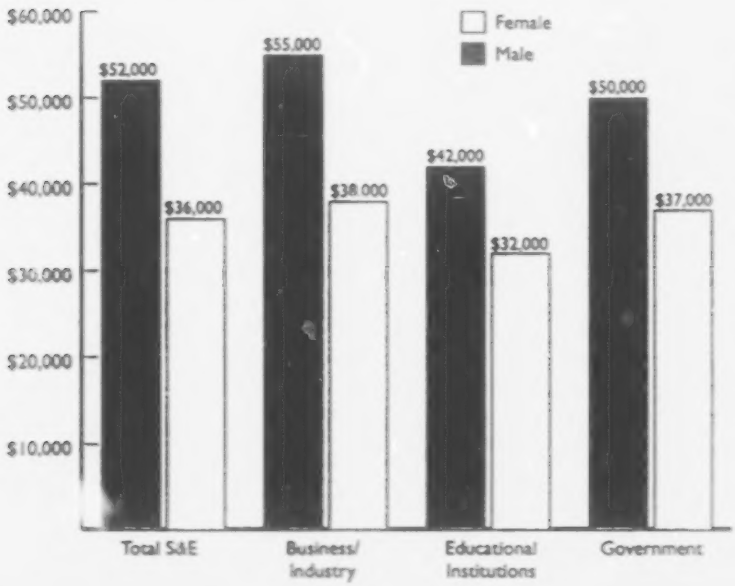
educate professionals and managers who need expertise in science and mathematics combined with other competencies. The programs lead to M.S. degrees in such fields as biotech management, bioinformatics, environmental technology, and physics with business applications *(Tobias & Birrer 1998: 215)*. Another approach to recruiting technology workers with business training—described by Janet Stoner, Texaco human resources vice president—is an executive business analyst program. "Under this program we're hiring MBA graduates with work experience in engineering, science, and business. Many of them will be women," explained Stoner. "Then we'll introduce them to Texaco with rotational assignments for two to three years. Those who perform well will move into leadership positions" *(Stoner 1999: 26)*.

In the Catalyst survey, most respondents stressed as positive attractions their perception that industry offers a faster-paced and more diverse career path, one that features applied science. A research and development vice president said that she loved science but was never attracted by the prospect of long hours in a lab. "Combining consumer research and working with the manufacturing process to really design the intended product has a kind of magical appeal to me," she explained *(Catalyst 1999: 13)*.

Barriers that remain

Whatever the advantages of the private sector for women scientists, the level playing field is some distance away. That is partly because fewer women are in these jobs. Women compose 45% of the workforce but hold only about 12% of industrial science and engineering jobs *(United States Department of Commerce 1996)*. The low proportion of women in these private sector jobs is mostly because women are less likely to be engineers or physical scientists, fields heavily employed by business and industry. In addition, 26% of the women and 15% of the men work in an educational setting *(National Science Foundation 1999: 101–103)*.

MEDIAN ANNUAL SALARIES OF U.S. SCIENTISTS AND ENGINEERS BY GENDER, 1997



NOTE: Psychology and social sciences are included in the science and engineering category.
COMPILED FROM: Scientists and Engineers Statistical Data System (SESTAT), National Science Foundation/Science Resources Studies Division (1997). *Characteristics of Scientists and Engineers in the United States*. Arlington, VA, pp. 1, 4.

Women in the science and engineering workforce are younger and paid less than men, and they are less likely to be employed full time. The salary differential is mostly due to the fact that women workers are younger and that men predominate in the highest paid fields. The salary gap increases with age, however. Among computer and mathematical scientists, for example, the 1995 median salary for women in their 20s with bachelor's degrees was $35,000, and it was $38,000 for men.

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But the median salary for such female workers in their 40s was $48,000, compared to $57,000 for men *(National Science Foundation 1999: 105)*. A survey by Women in Technology International found that glass-ceiling issues are particularly significant for such mid-career, mid-level women in science and technology related businesses. Women just starting out and those who have managed to reach the top echelons expressed the most job satisfaction, the surveyors noted, while "women 'in the middle' tended to express the most frustration" *(Women in Technology International 1997)*. Women of color constitute 19% of all women in science and engineering jobs. The fields they choose tend to mirror white women more closely than minority men, and their median salaries are similar to those of white women and minority men *(National Science Foundation 1999: 114)*.

Women in technical jobs are least likely to be comfortable in those fields, such as engineering, that are the most male dominated. "The corporate engineering culture is male-oriented, with intense pressure to conform to 'masculine' styles and deny issues of concern to women," reported Catalyst. "In this environment, a competent and confident woman is likely to be considered 'too aggressive.' Female engineers' comfort in the workplace can also be undermined by inappropriate behavior of male colleagues, including sexual harassment" *(Catalyst 1992: 3)*.

Starting with a small email list of colleagues in the computer industry, Anita Borg created Systers, a network that now has more than 3,000 members in 38 countries.

Anita Borg of the Institute for Women and Technology related an experience of having lunch with a female friend, a Ph.D. engineer at Compaq. Her colleague said to Borg, "I want you to know that the first time I met you was the first time in my life that I ever felt like I was both a woman and an engineer at the same moment." Borg believes this feeling resonates with many women who spend their lives "flipping between their professional and female selves" *(Borg 1999)*.

While acknowledging the traditionally masculine environment of many engineering worksites, Samuel C. Florman, author of *The Existential Pleasures of Engineering* and member of the National Academy of Engineering, suggests that his field offers "many pluses for women. It is more directly 'people-helping,'" he notes. "It is often looser, more democratic and less persnickety than science. And it is essentially an undergraduate discipline, much easier to enter and stay with than the professional science track" *(Florman 2001)*.

Corporate initiatives to advance women

A survey conducted over a seven-year period found that women were almost twice as likely as men to leave occupations related to science and engineering for careers in other fields *(Preston, A. 1994)*. Procter & Gamble, concerned that its women engineers were leaving their jobs during their first four years in industry at greater rates than men, discovered

that the two main reasons they left were because they did not like the type of work they were doing or they did not feel valued as employees.

To counter the first problem, the company beefed up its pre-recruiting efforts, making more use of co-op programs and summer internships that give undergraduates a taste of industrial work. The company found that women new to the job tended to be less familiar with tools and equipment than men who tended to have more childhood experience working with hand tools or on cars or household plumbing. Women less familiar, for example, with the names of tools and equipment would feel less capable and may be seen by others as less capable. So the company pared new employees with an experienced research associate or operator to get hands-on experience with equipment. Proctor & Gamble found that the most important thing the company could do to ease transition into the workplace was to assign a new employee a "real" project immediately, a specific task with technological challenge and a success measure that was clearly defined *(Maloney & Lingousky 1999: 138–9)*.

Hewlett-Packard's Technical Women's Conference, which highlights women's contributions to the corporation, began as a meeting of 400 employees in 1988; in 1995, 2,700 participated from around the world.

According to Marcia Reeves Simpson, a manager at the Mobil Technology Center, the need to recruit and retain women "is quantifiable and has a direct impact on the bottom line." Like many large corporations that had downsized in the 1990s, Mobil faced the task of replenishing an aging technical workforce. "At Mobil," said Simpson at a 1998 conference, "a company with approximately 6,000 engineers and geoscientists, 50% will retire during the next ten years. And, though 17% of Mobil's engineers and scientists are women, only 9% of its leaders are women. This impacts our ability to recruit and retain women. The differential exists for all underrepresented groups."

The company addressed the problem by setting goals of specific percentages for underrepresented groups in the workforce and throughout management, mentoring newly hired workers, focusing on early-identified talent in career development programs, using implementation measurements to emphasize accountability in diversity programs, tracking recruitment and retention statistics and surveying the effectiveness and utilization of employees. "Many companies have had similar programs for years," noted Simpson. "The major difference between then and now is the improved implementation quality and the accountability of leadership" *(Simpson 1999: 21)*.

Women surveyed for the Catalyst Fortune 500 study reported a number of barriers to success. One that was consistent with other Catalyst research was the tendency for male supervisors to perceive a greater risk in promoting women. A man's promotion tended to be based on his potential, whereas a woman would have to demonstrate that she actually

could do the proposed job *(Mattis & Allyn 1999: 150)*. Those women scientists who had risen to senior management levels reported going out of their way to learn the business side of their company—by attending programs sponsored by their employers or earning an additional degree *(Mattis & Allyn 1999: 153)*.

In a number of companies, networks help to alleviate a woman's feeling of isolation in a male-dominated field. In 1990, two women at Texas Instruments noted that, with only one or two women in each department, they were often left out of the communication loop. So they launched the Corporate Services Women's Initiative to reach out to all women within the company, linking 50 female engineers to each other, job opportunities and top management. The group spawned at least five similar efforts throughout Texas Instruments, a highly decentralized company. Colleen Dominguez, who co-founded the network, said she and her partner sold the initiative to management as "something they could do for the company, rather than something the company could do for them" *(Catalyst 1992: 46)*.

Anita Borg has done similar organizing across company and national boundaries. Starting with a small email list of colleagues in the computer industry, she created Systers, which now has more than 3,000 members in 38 countries. She believes she has finally merged her feminist and technical identities, and just in time. In technology, she said, "every decision we make about what we're going to build, how we'll build it, who's going to pay for it, it's all socially constructed, and women are very rarely part of it" *(National Council for Research on Women 1999)*.

"Women have been tremendous contributors to corporate America when we allowed them to do so."

A recent survey sponsored by Women of Silicon Valley shows a regional growth of women in technical careers. The percentage of female electrical engineers is four times the national average; 31% of the region's computer programmers are women, compared with about 26% nationally. Still, a plurality of the women surveyed, 41%, agreed that they had to "fit into a masculine workplace" to get ahead; 30% are now, or intend soon, to become self-employed *(Flynn 2001)*.

In 1998, Borg founded the Institute for Women and Technology to increase the impact of women on technology and to increase the positive impact of technology on the world's women (see *Conversations About the Future*, in this report, page 106). The institute sponsored a Senior Women's Summit in September 2000 on Cape Cod in Massachusetts, which drew prominent women in computing from universities, industry and government. The gathering discussed technology issues in a broad context, considering outcomes in terms of community and society. "Women want to know they're making a positive impact before they invent something, and working together allows us to draw strength and motivation to move the future in that direction," commented participant Valerie Taylor, an engineer at Northwestern University *(Institute for Women and Technology 2000)*.

A program at Hewlett-Packard that began in 1988 is designed to increase women's visi-

SPECIAL REPORTS

Peer Review in Sweden and the Netherlands

Adapted from European Technology Assessment Network (ETAN) *Report on Women and Science*, 2000, 33–35

IN AN INFLUENTIAL STUDY PUBLISHED IN 1997, Swedish researchers Christine Wennerås and Agnes Wold took advantage of a law allowing access to public papers to find out why it was twice as likely for the Swedish Medical Research Council to grant a male applicant a postdoctoral position than a female one. They found three factors determined high scores: the applicant's scientific productivity; the applicant's gender, since men received higher scores than women with equal productivity; and professional ties to one of the peer review committee members. Given the extra competence points awarded to a man because of gender, the study determined that a woman had to be 2.6 times more productive to be perceived as equally competent.

Following publication of the study and partly because of its findings, the board of directors of the Swedish council was replaced. The proportion of female evaluators was increased, and strict guidelines and monitoring processes were introduced to make peer review fairer. The reforms increased the transparency of the evaluation process so that all applicants now routinely receive their evaluation scores and know the identity of the peer reviewers.

The Wennerås and Wold article inspired a similar study in the Netherlands conducted by the Dutch Association of Women's Studies. Researchers looked at applicants to the country's main research granting agencies and concluded that gender played an independent role in the evaluation of women, regardless of academic merit, whereas assessment of male applicants was found to correlate with their productivity, age and the speed of their promotions. The gender difference for women depended on the discipline: women evaluated as better than male applicants seemed to receive a bonus in the exact sciences whereas in the biological, oceanic and earth sciences, women with equal track records to men failed to receive grants. At one of the agencies, the Netherlands Organization for Scientific Research, of 240 external advisers involved in peer review only four were women. □

Funding: Sloan Foundation—Altering a Male-centric Work Environment

Ted Greenwood, who holds a master's degree in physics and a Ph.D. in political science from MIT, has been program director for the Alfred P. Sloan Foundation since 1992. Testifying before the Commission on the Advancement of Women and Minorities in Science, Engineering and Technology Development in October 1999, he explained the rationale of a number of Sloan Foundation programs to increase the representation of women and minority members in technological fields. One of these, the Pre-Tenure Leave Fellowship Program, provides resources for women—or men—to take a paid leave for pregnancy, following childbirth or to care for a family member in crisis and then resume their research. Following is an excerpt of his testimony.

THERE ARE DIFFERENCES BETWEEN WOMEN AND MEN that must be addressed if more women are to be induced to enter and stay in science, engineering and technology.

There are many—both women and men—who assert that if only women were given the same education and career opportunities as men, then young women would be as present at all levels of the science, engineering and technology workforce as men. I suggest to you that this view is wrong and that policies based on it alone will fail to achieve gender balance.

In the physical and biological spheres it is a truism to point out that women and men are different. But there are differences in other spheres as well. I do not mean to suggest by this that all women are the same or that all men are the same, but rather that, on average women and men have different characteristics.

In what spheres do these differences appear? I will mention just a few that are salient. The learning styles and recreational preferences of women and men are different. The ideal way of balancing work and family responsibilities for women and men is different. Styles of personal interaction with co-workers and management styles of women and men are also different.

We need to redesign our educational and business institutions to meet the needs of and to respond to the perspectives of women as well as men.

Because of such differences, if we want women to achieve equality in the science, engineering and technology workforce and society to reap the benefits of having significant numbers of women in these fields, then we need to redesign our science, engineering and technology educational and business institutions and to create new kinds of career paths so that they meet the needs and respond to the preferences and perspectives of women as well as of men. So long as we expect women to fit into the existing institutions and career paths, which were designed by and for men, we will get only that fraction of women who are willing or able to tolerate a male-centric environment.

The implications of this are many and very profound. I limit myself to one area, the balance between work and family responsibilities. Women more than men wish to avoid subordinating their family life to their work life and are more often willing to accept, if necessary, jobs with lower pay, lower prestige, less demanding schedules, and less responsibility to achieve this result. If we wish to induce more women to aspire to positions of responsibility and leadership, then career paths and work rules within these fields must be redesigned to accommodate, not penalize, women who choose to have and take care of their children. ■

bility in the far-flung company. Its Technical Women's Conference, held every two years, attracts participants from around the world. Forums highlight women's technical contributions and promote contacts among the women. At the 1988 conference, 400 employees participated. By 1995, there were 2,700 *(Catalyst 1999: 57)*.

When work meets life

Hewlett-Packard is among the corporations that have started to address a major concern of women, and men, in the workforce—the integration of family life and work. Author Suzanne Braun Levine described how Hewlett-Packard CEO Lewis E. Platt, now retired, woke up to the business consequence of running a workplace inhospitable to employees' family responsibilities when his wife died of cancer. He was left to raise two daughters, ages nine and eleven, while maintaining his hard-driving career. The experience of being suddenly thrust into a different role, Levine reported, "shattered his old assumption that the difficulties women executives were having were of their own making." He could cope no better than they did, he discovered. Under his leadership, Hewlett-Packard began to offer flexible work schedules, work-at-home options, shared jobs and unpaid sabbaticals. The turnover rate there is less than a third of the industry average of 17% *(Levine 2000: 78)*.

Such efforts are most successful when they are promoted by top management. When General Electric, after surveying the employees in its aerospace division, began to offer family leave and a flexible work arrangement policy, about 1500 of the division's 40,000 employees took advantage of the new options. A program by the Dow Chemical Company serves the interests of dual career families, many of them marriages where both spouses work for Dow. When the company re-locates an employee, it provides up to three months' reimbursement for a partner's lost income while he or she looks for a job in the new location. If the couple decides to live apart, Dow reimburses commuting expenses. The program also offers job-search help and counseling *(Catalyst 1999: 58)*.

A survey conducted over a seven year period in the 1980s and 1990s found that women were almost twice as likely as men to leave occupations related to science and engineering for careers in other fields.

A survey of 265 women professionals in information technology suggests that women may be the "canary in the coal mine," alerting the nation that work and family needs must be better balanced. Conducted by GLS Consulting, Inc. in Boston, the survey revealed that 68% of the women expressed deep concern with the stress caused by the long hours and intense commitment their work required; 65% said the work had a negative impact on their personal lives. "Especially in IT, there's been the notion of heroic leadership: 'The longer I can work, the better,'" commented Mary Mattis, senior research fellow at Catalyst. "I don't think that's

a lifestyle that is realistic for most people and especially for women. And if you asked men, I suspect you'd have similar findings" *(Melymuka 2001)*.

Engineering alumnae of Northeastern University, asked about their careers in a survey of 1500 women conducted in 1996, reported conflicting time demands in raising a family and succeeding on the job as the most pervasive problem. "Achieving a good balance between career and family is the number one issue in my life," said one respondent. "Women professionals are expected to work as hard or harder than male counterparts, and not to be assertive (or they'll scare their male counterparts), and be committed mothers. It's impossible to do all successfully." Of those surveyed, 34% experience this difficulty to a high degree; 23% to a moderate degree; and many of the 42% who said it was not a problem were not wives and/or mothers.

One respondent said simply, "I couldn't do both, so I chose to stay home and raise three children. This took ten years and my education became dated." One younger alumna believed she had more options:

> My current job as an engineer for a large defense contractor is not particularly challenging, but the benefits and flexibility are incredible. My main focus right now is my family, so I am not looking for a prestigious career as an engineer. In fact, if and when I get laid off from this position (directly tied into the defense budget), I will most likely make a career switch to something more satisfying. I have never personally experienced discrimination—I've been treated as well or better than men. It's difficult to be an engineer and mother, unless you find the right company *(Levenman 1999: 52, 56–57)*.

A Catalyst study of MBS graduates in the information technology industry found that 75% of both women and men take advantage of flextime arrangements and 40% telecommute or work from home. In this study as in previous Catalyst surveys, more women than men work on a reduced-hour schedule (15% versus 5%) *(Catalyst 2000: 8)*.

A woman working in the private sector should not get so comfortable at a large company with good benefits that she fails to nurture her own career, warned Andrea Sanders, a chemist who is vice president of Together, a subsidiary of VIE Inc. "One of the success factors for me was having the guts to leave a very stable company that I had been with for 14 years and take a risk with a small company that was privately held. It was a big risk, but I was willing to take it because I saw a glass ceiling in the company I was with" *(Morris & Alpin 1999: 156)*. It may be true, as sociologist Cynthia Fuchs Epstein discovered when studying law firms, that family-friendly companies may not be the best environment for the upward mobility of those employees who choose to use such benefits *(Epstein et al. 1998)*.

Judith Giordan is a chemist and fragrance industry executive who had to move on from a job with a large corporation. The first woman hired by that company to manage a major operation, she found herself made a scapegoat by her male supervisor. She advised young women to "expect inequity. Don't expect the company is going to try to help you out. The company believes it is there to make money." She suggested that women enlist the help of male col-

leagues to deal with issues that men should have a stake in, such as family leave, so that women do not always have to "carry that gauntlet" *(Mattis & Allyn 1999: 159–160)*.

How women fare in biotechnology

In some fields, women scientists are more of a presence and conditions seem to be better. In biology, from 1973 to 1995, the percentage of women working in the education sector doubled, growing from about 13% to about 28%, while in industry, the participation rate of women biologists tripled, from around 7% to nearly 23%. In government, women biologists increased their share of jobs from 10% to 25% over the same period *(Greenwood 2000: 71-72)*.

Susan C. Eaton of Harvard's John F. Kennedy School of Government looked at biotechnology firms, where women are nearly 50% of professional scientists compared to 28% of doctoral level biologists in industry overall. In a study of a small cluster of biotech firms in the New England area, she found that the structure of the industry could work in ways that were more hospitable to women. Most firms were less than 15 years old and operate in a highly speculative environment. "The small to medium-sized, entrepreneurial, and highly insecure firms in this sector are much like those we expect more employees to work for in the future," she said.

From interviews with women in the field, Eaton found that while the insecurity was upsetting, it was impersonal and affected both genders equally. The work was often structured to allow flexibility and was both autonomous enough to allow personal achievement and integrated enough to provide support from colleagues. Because the work tended to be organized in small teams, there were ample management opportunities for women, and women's tenure in the firms tended to be longer than the men's, which also made them management candidates *(Eaton 1999: 175–181)*. Vicki L. Sato, president of Vertex Pharmaceuticals, warned that women are seldom present in senior management. Only 5% of the companies in the survey had women CEOs. She commented that "while many companies employ an informal version of flex-time, real commitment to part-time work runs counter to the driven, 24-hour workday culture of a young and hungry company" *(Soto 1999: 189)*.

Eaton's study of the impact of gender was part of a larger, interdisciplinary two-year study of the biotech industry, for which Paula Rayman, director of the Radcliffe Public Policy Center, served as co-principal investigator. In another part of the study, researcher Ann Bookman looked at the family and community life of biotech workers and found definite gender differences. According to the project report, women who work full or part time in biotech, like the non-scientist wives of biotech employees, "seem to carry a greater share of responsibility for community building than men, and are more conscious of the shape and membership of [social and community] networks than men" *(Carré & Rayman 1999: 12)*.

In the context of the pharmaceutical industry, signs appear that the culture may be responding to the increased number of women scientists in biotechnology. Pfizer Inc. senior vice president Nancy J. Hutson, director of Groton Laboratory, believes that competitive, aggressive, macho behavior is still an asset in academia. But "as the pharmaceutical industry evolves," she said, "these behaviors are becoming less valued. It is critical that we operate in

large, very complex teams to see a project through the 10 to 15 years to fruition." Hutson thinks it is crucial for a woman to select a good mentor, who "need not be another woman." She believes in a broad network. "As scientists, we have the ability to network outside our jobs, and establish a high profile" *(Hutson 1999: 193–194)*.

High-tech opportunities

An incubator for women entrepreneurs starting high-tech businesses is one of the projects of California philanthropist Catherine Muther. A former senior market officer at Cisco Systems, Muther took money she earned from stock options and, in 1995, founded the Three Guineas Fund, the name derived from a Virginia Woolf essay. Muther has devoted $10 million of her personal wealth to the foundation with a goal of expanding educational and economic access for women. She sees herself as a new economy philanthropist, one who invests in long-term goals.

In partnership with the David and Lucile Packard Foundation, BankAmerica, the W.K. Kellogg Foundation, a number of San Francisco foundations and the city and county of San Francisco, Muther founded the Women's Technology Cluster, which in 2001 was home to 10 startup high-tech companies run by women. The young CEOs, such as Tiffany Bass Bukow—who launched a financial services site for women called MsMoney.com—are provided access to ideas, expertise and financing *(Zich 2001)*. The startup companies receive market rate office space with shared facilities as well as management and mentoring help, and they exhibited a diverse employee pool as of the end of 1999: 63% white employees, 23% Hispanic, 11% Asian, and 3% African American *(Women's Technology Cluster 2000)*.

In an interview for the Stanford business school alumni magazine, Muther talked about her philanthropic goals, "What we're doing is not about preserving and maintaining. When someone comes to me and says, 'Let's invest in keeping this the way it is,' I'm not interested. Here at Three Guineas Fund, we ask ourselves if there is something we can do to influence change. We see a systemic problem related to women's access to capital, and so the focus of the foundation is on providing access" *(Zich 2001)*.

Lilian Shiao-Yen Wu, a consultant in technical strategy development for IBM, believes that information technology offers ever widening opportunities that fit with women's tendency to choose work with social content. IT, she said, "is becoming pervasive, more complex and intertwined with the telecommunications, media, and entertainment industries. It is in our homes and where we work." As a result, the field offers careers both for people "who care deeply about the uses of computers in our lives" and those "who care passionately about the science of computers themselves, and for every shade of interest in between." She cited the need for managers in the utility field, as the electricity industry moves from monopoly to open market conditions, to find complex solutions that involve not only providing uninterrupted power to customers but meeting competition and confronting pricing and financing challenges. "My observation," she said, "is that many women both find this type of work interesting and rewarding, and are good at finding inventive solutions" *(Wu 2000: 40)*.

PART 4 RECOMMENDATIONS AND CONCLUSIONS:

- ❑ **Demonstrate leadership at the CEO level to institute family-friendly policies, and to make sure employees feel empowered to take advantage of such benefits.** To be successful, these policies must be vigorously promoted by top leadership. Surveys repeatedly reveal that a leading concern for women in science and engineering careers is their ability to balance work, family and community demands. In lobbying for such policies, enlist the efforts of male colleagues, who have an equal stake with women in balancing work, family and community life.

- ❑ **Develop programs that demand accountability of management at all levels to gender equitable practices.** Catalyst studies and anecdotal information indicate that managers tend to perceive promoting women is riskier than promoting men, particularly in male-dominated fields. Design equity programs so that managers are aware of such biases. Corporations have found that effective implementation and leadership accountability can spell the difference between successful and unsuccessful inclusion programs.

- ❑ **Promote capable women to senior decision-making positions.** Such women will provide role models for younger women, making traditionally male-dominated fields more attractive.

- ❑ **Develop strategies to create and manage a more diverse workplace. Institute thoughtful and tested management techniques to meet the initial challenges of a diversified worksite.** Recognize that broad life experiences offer richer interactions; people from different backgrounds ask new questions and supply valuable insights based on their perspectives. The technological challenge of the range of social and environmental problems facing the world requires the talent of all potential science and technology workers.

- **Support networking and mentoring interventions to encourage women employees and people of color and to make those who are successful more visible to their colleagues within a corporation and in the profession as a whole.** A Hewlett-Packard yearly conference designed to enhance networking and highlight the accomplishments of women professionals has been so successful that participation grew from a couple of hundred to thousands of employees from around the world over a seven-year period.

- **In recruiting, emphasize hands-on research opportunities and the chance to work on real-world applications,** which are often very attractive to women undergraduates and graduates in engineering and computing jobs as well as other scientific fields. Undergraduate and graduate students report having little information about opportunities in science and industry, compared to what they know about academic careers.

- **Assign newly hired scientists and engineers quickly to specific tasks with technological challenge and clearly delineated goals.** Women engineers have been found to leave their jobs within the first four years at a greater rate than their male colleagues. Assignment to what a new employee perceives as a "real" project as opposed to a training exercise can ease a recruit's transition into the workforce and contribute to higher retention rates.

PART 5

CONVERSATIONS ABOUT THE FUTURE

Interviews with

Shirley Ann Jackson

Donna M. Hughes

Anita Borg

Shirley Malcom

The National Council for Research on Women asked four leaders of the scientific community to comment on the future for women in science and technology. These women, from different disciplines and diverse backgrounds, were asked to identify some of the remaining barriers for women and how to make space for women's leadership and perspectives in science, technical and engineering fields. They give specific suggestions for achieving the kind of institutional change that would allow science and engineering endeavors to flourish and address wide ranging aspects of what the future could hold. Shirley Ann Jackson and Donna M. Hughes give broad views of complex equity issues, from quite different perspectives. Anita Borg and Shirley Malcom focus on innovative approaches to making significant institutional change.

SHIRLEY ANN JACKSON is president of Rensselaer Polytechnic Institute. She is former chairman of the U.S. Nuclear Regulatory Commission and was a theoretical physicist at AT&T Bell Laboratories. She was the first African-American woman to receive a doctorate from MIT and one of the first two African-American women to receive a doctorate in physics in the U.S.

Institutional change really has to do with changing the culture and the values of organizations. Programs alone cannot bring forth institutional change. The driving force tends to come from the leadership of major institutions:

- What tone does that person set?
- What expectations does that person have for how the institution will function?
- How much are initiatives—such as mentoring programs—treasured and rewarded activities in an institution, as opposed to being something for people to engage in during their spare time?
- What are the hiring practices?

Leadership in these areas begins to affect the culture and values. That's number one. Secondly, leading organizations have an impact, because they end up being de facto role models for other institutions in a society. When a given university of a certain status or a major corporation places a woman in a position of power, such as president, then other institutions are more likely to follow suit. When more women are in major decision-making roles in business and higher education, we begin to get a critical mass. That truly begins to change the culture.

Personally, I have always been a focused, motivated person. I had the fundamental, driv-

ing interest in science, doing it, and being successful. That's not to say that it was always easy, but when I got the most discouraged, I tried to keep my eye on the end game.

Today, with women in science and technology, you have a real pipeline issue. There is a kind of enthusiasm that children have about whatever they look at, and we need to encourage that early interest. Early preparation is paramount. Studies have suggested that middle school is about the latest point at which we can hope to capture and/or preserve the scientific interest of students, particularly young women.

We also need to support math and science teachers in elementary and secondary schools, because they are the ones who ignite student interest and keep them motivated. Teachers have to feel that they have good career paths and that they are well prepared in their subject matter. We also have to develop their sensitivity about how girls are dealt with in particular. I have always felt that we need something like a corps of math and science teachers who would be recruited jointly by local school boards and companies involved in science and technology. These companies would guarantee the teachers summer employment in a technologically rich environment for, say, a four or five-year period. The teachers would really be motivated and their salaries enhanced.

Equity for women in science is an important goal for the entire nation. When you have a diverse workforce, made up of people with broad life experiences, you have much richer interactions than if the group was all male or all from the same country and culture.

My point of view—and it is one I hold very strongly as president of a technological university—is that talent resides in all groups and genders. Therefore if one is really looking at a robust economy based on science and technology, and if you have a myriad of social and environmental problems that have to be addressed, you do not have anybody to waste!

"We need to support math and science teachers in elementary and secondary schools, because they are the ones who ignite student interest and keep them motivated."

Does it not make sense to have a larger talent pool? That's the real message. We should ensure equity in science and technology because we need to retain 50 percent of our population, doubling the base of talent from which to draw.

Here at Rensselaer we have a number of initiatives to encourage young women. We have a three-two program with Spelman College that allows us to provide the opportunity for minority women to earn degrees based on a liberal arts curriculum as well as engineering and science. A number of engineering schools have such programs. The students spend their first three years at the liberal arts institution and then come here for a carefully planned course of studies that they complete in two years. They end up with a bachelor of arts degree from the home institution and a bachelor of science degree in engineering from Rensselaer.

We are looking at other women's colleges to see if we might expand our focus.

There is also a WISE—Women Interested in Science and Engineering—program for freshmen and sophomores at a high school in Connecticut. If the students complete the requirements in good standing, they can get automatic admission to Rensselaer. It is a weekend program of courses ranging from AP computer science to engineering design. We also have two-week residential sessions for academically talented high school students, primarily 11th graders who are minority and/or women students, to explore engineering opportunities. In addition, there is a Capital Region Scholars Program for juniors and seniors from high schools in Albany, Rensselaer, Schenectady and Saratoga counties. They can take college courses at Rensselaer. It is not specifically geared toward girls or minority students, but it turns out that Emma Willard, a boarding school for girls, is one of our most active participants. Many of the girls end up coming to Rensselaer.

"When I was an undergraduate at MIT, women were less than 5% of students. Today there are 40%."

A mentoring program for women matches first-year students with upper-class students to help them through the significant transition from high school to college. The match-up takes place during the summer, and there is an ice cream social at the beginning of the year and ongoing monthly activities. The program has an enormous impact on our ability to attract women to Rensselaer and also to retain them. If you compare our fraction of women to MIT or Georgia Tech, it's small. But our retention statistics, our measures of how satisfied women are with their experience here, are fabulous.

I view myself as a transition person. I lived through a time when women and minorities had very different prospects. Obviously I have had opportunities that I have exploited along the way and done well. But what makes me optimistic from where I sit today, as head of a technological university, is seeing that if we intervene in the right ways, we can really make a difference for all the talented women and young girls. Women have made breakthroughs at the highest-level positions in government, industry and academia. I believe that will continue, because as women gain opportunities to lead, they will be successful in terms of all the conventional measures. They will also provide a different kind of leadership—one that is more inclusive and sensitive to developing the whole person. Women can lead and create or recreate high-performance organizations and at the same time bring all the people along.

Today we have many more women CEOs. Being a woman in the President's cabinet is obviously not a big deal these days. The real measure of women's talent and performance is in the statistics. When I was an undergraduate at MIT, women were less than 5% of students. Today there are 40%. That is what I mean about the importance of what happens at a leading institution. Here at Rensselaer, women were once at 0 or 1%. Today it is 26% and growing.

DONNA M. HUGHES is director of the Women's Studies, Science and Engineering Curriculum Project at the University of Rhode Island, where she holds the Eleanor M. & Oscar M. Carlson Endowed Chair in Women's Studies. She earned her undergraduate and master's degrees in animal science and her doctorate in genetics, and she is engaged in research, teaching and writing on women and gender in relation to science.

The status of women and girls in science and technology now is very mixed. Women and girls have made a lot of progress in some areas, but are stalled and even declining in their participation in others. In biological sciences, women have done quite well. They have probably reached parity with men as undergraduates. It's only in graduate school and university teaching that they start to lose some of that momentum. In computer science, however, we've seen the numbers of women really drop. An instructor here at the University of Rhode Island told me that when she last taught one of the required courses for the major, there were no women. So in some areas there has really been a regression.

Women are as capable of learning different ways of doing things as men, but the culture is quite different in some of the sciences. In computer science, one of the contributing factors has to do with the increase in male oriented computer games that a lot of the boys learn to play. And if you read very much about the culture of the workplaces in the high-tech world, it's very competitive for the people who are becoming millionaires overnight. It's the hotshot young men who are sleeping under their desks, working all night, and in some ways having a great time—but it's not a culture that is at all friendly to women. One of my secondary areas of research is the sexual exploitation of women, and it has been the sex industry that has really opened up the Internet for commercial development. It includes some of the companies that consistently make the most money on the Internet, and that kind of a culture tends to corrupt the whole field. In mainstream computer magazines, sex industry sites are held up as a model for how companies should develop. I think those attitudes filter clear down into the curriculum.

"It's the hotshot young men who are sleeping under their desks, working all night, and in some ways having a great time—but it's not a culture that is at all friendly to women."

As I've done more reading on the history of science I've noticed a parallel between the participation of women in science and the strength of the women's movement. There were significant numbers of women in science and engineering at the turn of the century, and that peaked around 1920 when women got the vote. Women's participation started falling off,

although it jumped up again during the World War II years. But in the '50s and the early '60s, a very low point for the women's movement, there are almost no women in science. If you look at when women's participation starts increasing, it's right when the women's movement starts picking up. I believe the women's movement has sort of plateaued over the last decade. It's been in a maintenance mode—trying to hold on to reproductive rights, for example. And we see that same plateauing in the progress of women in science. When the women's movement is stronger, when there's something to struggle for, it makes women a bit more feisty I guess. Also that sort of climate makes the institutions a little more open, a little less likely to shrug off problems like sexual harassment if they feel there are going to be a number of feisty women around saying hey, you can't do this.

"People who come to science from different locations, be it because of gender or race or class, tend to ask different questions rather than accepting the mainstream assumptions."

People who come to science from different locations, be it because of gender or race or class, tend to ask different questions rather than accepting the mainstream assumptions, so it is important to open up the institutions. I'm a supporter of all the science programs for women and girls, but they don't necessarily make a lot of institutional change. Once the programs are over, the old culture can just reassert itself. I sometimes feel we're just rallying the girls onward against the wall and hoping a few more manage to make it. If you rally ever greater numbers, you can lose a lot of them along the way and still make some progress. There are fewer programs that have targeted institutional change.

In my work, we've done a lot around curriculum change. But many of the people I work with on these grants still only look at women in science. They are reluctant to take on that next step of looking at science itself. A lot of women in science and engineering seem reluctant to identify themselves as feminists, and I think that's to their detriment. Not that everyone has to be in ideological lockstep. But at the same time, when you see that it's when the women's movement is the strongest that women do the best in these fields, and they are saying I don't really want to stand out as a woman, it drives you crazy. A lot of people want to exclude the word "women" from project and conference titles because the men won't come if the word "women" is used. I hear a lot of this because of my connection with women's studies. It's a fear of association that affects women across the spectrum, from those in their sixties getting ready to retire down to 19-year-olds.

Taking an area like the Human Genome Project, it's important to think about how this new information, which is given out as gender neutral, is going to be used. Most of the testing will be carried out on women. Certainly almost all of the prenatal diagnostic procedures are done on women. We have to think of the implications of that. I see so little cultural change

SPECIAL REPORT

FATIMAH JACKSON: A CRITIQUE OF THE HUMAN GENOME PROJECT

Currently the Human Genome Project seems to suffer from an unquestioned, unexamined, spontaneous over-extrapolation of European-American and male patterns as if they were human universals. One short trip to any demographer's workshop will tell you that world patterns indicate that to be European, or European American, and male is not to be representative of the majority of humanity. We have been so terribly misinformed and miseducated that we are preconditioned to view whiteness as norm. Whenever I hear people talk about minorities, I wonder whom they are talking about? We mean minorities in what context?... To me, this is a blindness that may facilitate harmful genetic intervention among non-European groups. If someone else is the norm, there is no space for me to be myself (Jackson 2001: 49–50).

Looking at the Human Genome Project (HGP) from the vantage point of a population biologist and biological anthropologist, Fatimah Jackson believes that, in spite of the project's various reincarnations, it has remained nonrepresentative. She and others see the HGP in an historical context of scientific research interactions with the African-American community and argue the potential dangers of approaching a major scientific undertaking from a limited perspective. The University of Maryland professor points out that the genes used as the database for what she calls the "largest and most extensively funded national science project since the Apollo space mission" (Jackson 2001: 35) come primarily from a small group of families of North Atlantic origin that had been the subject of previous genetic study. "Preference was given to individuals whose cells were already transformed and part of an established data set, or who happened to be available ad hoc to a particular researcher for inclusion" (Jackson 1999: 181–182).

Superficially, she explains, it may have seemed practical and non-problematic to use these easily accessible cell lines. Since humans constitute a single subspecies, "the chromosomal locations of specific human genes would be expected to be basically consistent from one individual human to the next. At a purely structural level, without any consideration given to human history, biodemography, or population biology, absolutely any human or group of humans could constitute the database for the HGP without jeopardizing its utility for all of us. But to assume that the Human Genome Project mandate was solely to identify the locations of the genes without characterizing the actual genes would be dangerously naïve and myopic" (Jackson 1999: 182).

Francis Collins, director of the National Human Genome Research Institute, has said that the project was not intended to be genomically representative of human variability, but Jackson argues that since its funding "rested on the promise of chronic disease intervention, macroethnic variability should have been a salient part of the project's design from the beginning." Since the mid 1990s, the HGP has gathered non-European derived samples for comparative molecular studies, and a sampling technique, ethnogenetic layering, was developed to facilitate such work. "This new approach now increases the probability of a serious inclusion of African-American haplotypes into the most sophisticated genomic studies, although they would remain largely absent from the public reference base," Jackson explains *(Jackson 1999: 187)*.

One of the lessons to be drawn from the HGP process, says Jackson, is that "at any stage in the scientific endeavor, inclusiveness cannot be assumed. Rather, exclusiveness is often the rule and it is frequently a reflection of power" *(Jackson 1999: 187)*. In 1994, she and other colleagues outlined a set of principles to guide genetic research called the Manifesto on Genomic Studies Among African Americans. It requires that African Americans be fully included in any world survey of genomic diversity and that, given the extent of genetic heterogeneity already uncovered among African Americans, no scattered, opportunistic sampling would be sufficient. Acceptable studies would include representatives of the African-American community in all aspects of the research process, and such studies would set a priority on establishing links between African Americans and continental Africans and others of the various African diasporas since, "for too long, research dollars have been squandered on meaningless 'black-white' comparisons, most of which provided few positive policy results for the African-American community." The manifesto also requires that genomic sampling of African Americans be linked to improvements in health and educational services to the African-American community *(Jackson 1998: 166)*.

As the HGP moves from the identification of the normal sequence of the human genome to the complex study of the functional affinities among these genes, argues Jackson, it must radically broaden its sampling strategy. "The ability to accurately depict the true ancestral and functional affinities among these genes will require more precise bioanthropological and biohistorical considerations going into the selection of the groups and individuals whose genes will constitute this genomic periodic table." More and more functional genomic studies indicate that located genes must be considered in the context of the real-life experiences of individuals whose genes are of interest. "We don't know if the same genes that cause specific disease in North Atlantic Europeans and their descendants will produce the same disorders in a different genetic or environmental context. Without variation integrated systematically and intentionally into the HGP, we may never know" *(Jackson 2001: 42, 46–47)*. ■

in science. Some of the strongest women on campus—women I work with who are absolutely committed to getting more women in science—are unwilling to talk about gender in science, about the culture of science itself. They believe very strongly in the scientific method and its infallibility, and they are completely socialized into the culture of individualism and meritocracy. The feminist critique of science points to the fallacies of scientific objectivity and of that culture.

I'm optimistic, though, about how well women do in the life sciences and the increasing numbers of women who are asking different kinds of questions in those areas. For example, Fatimah Jackson at the University of Maryland is critiquing the genome project, and because she is a professor at an important university, she is getting recognition for challenging the assumptions made in that project. (See *A Critique of the Human Genome Project*, page 104 in this report.) Also, I'm happy that the work I do enables me to be not only interdisciplinary but multidisciplinary. You can look at gender, at race, at class. You can look at all sorts of critiques of world politics, of economics, as well as the science and bring a lot of these strands together. There has been increasing specialization, which pulls you away from being able to see the science that you're doing in a social context. We need more multidisciplinary work.

ANITA BORG created the Institute for Women and Technology at Xerox's Palo Alto Research Center, an experimental research and development organization. She founded the Grace Hopper Celebration of Women in Computing, a conference that features successful women in computing.

Image is significant when it comes to computer science. In the '70s and '80s, when the field was new, it had no image. That has changed dramatically. Now, early on in their lives, girls develop a sense that computing and technical jobs are not places for them. The image also impacts the families, teachers and mentors of girls and young women—those who are going to advise them about what's an appropriate place for girls, whether it will be too hard, or it won't be fun, or it won't be nice. That doubles the impact. So women's numbers are shrinking back to be much more like those for women in engineering.

Part of the image of working on computers is working to create gadgets—techie stuff having nothing to do with people's lives. The work deals with technology, not people. And if you talk to girls—and this is tied into what the institute does—you know that young women want to have a positive impact on people. In fact, the future of our planet is going to be tremendously affected by technology. An important way to have an impact on people is to have an impact on technology. If we can get across that there are powerful ways to have a hugely positive impact on people, to interact with people as you create the technology that is going to help make a better world, then maybe we can turn that image around. But that also means turning around the entire way industry and the educational system work.

We have begun a project that brings together computer science faculty and students with

women involved in the local community to brainstorm about things that would be valuable to them—to all of them. These are incredible sessions. The nontechnical and technical folks develop a respect for each other, and they realize that they all can have brilliant ideas together. You don't have to know technology to know what you need in your life. The technical folks say, wow, these people have great ideas, and the nontechnical folks say, well, I do know something about technology. After the workshops, the undergraduate students integrate the ideas in class or group projects. A number have built prototypes for which they get credit in their courses and learn about what they could build.

We're working with six colleges now. At Purdue and Santa Clara universities, students have built prototype communicators and robot vacuums. We hope to expand the program into graduate courses because many of these ideas are far beyond what any of the students could actually build. This is an entirely new way of driving learning and research—it could be used in any science or engineering field. Asking what women in the community want makes students think about why they are learning programming, for example. It's not just a formula; it's for something. Normally, students learn fundamentals and are even lucky to apply them before they are out working. But here, a student's work can be driven by what some real person actually wants. As we get this program going, we intend to build a network among the groups at the universities so that the students can collaborate with each other. Ultimately we hope to create a large network of women who can stay connected through their careers, as they go to graduate school and become professors and professionals.

The community involvement is very important. Initially, it was scattered individuals who were brought in, but it is turning out that working with local organizations makes more sense. The initial workshop will come up with ideas, and then as the students work on their projects, they will periodically get together with people in the community, asking, are we doing the right thing? Is this what you want? Does this make sense to you? And keep them involved. The first year, we were able to make sure that there was ethnic diversity in every one of the workshops—people of different ages, of different races. We are committed to the broadest involvement. Expanding to just white women is not sufficient.

"The future of our planet is going to be tremendously affected by technology. An important way to have an impact on people is to have an impact on technology."

Part of what keeps women away from computer science is an image of all these greedy guys creating stuff—that guys' having wild fun is where the wonderful ideas come from—in an all guys club. I worked for many years in a lab with a bunch of fun guys, and it had some of that playful attitude. It really was fun. But they were also good, caring, excellent colleagues. I also did work in a place where people slept under their desks and were very weird.

And I said, you want the best out of me? Sorry guys, I don't work that many hours. You're not working when you're doing this. I have a social life that's not this. But it is true that the image has grown completely out of proportion.

People are beginning to figure out that this kind of behavior is stupid. But right now they think most of the people coming out of school are immature males, and, because of the shortage, they cater to that. Women are not there filling the slots, and the companies are too shortsighted to go out of their way to recruit them. Even when human resources people ask, "How do we get the women, how do we bring in the minority people?" they only want to know how to get them this week. They are unwilling to consider their environment and their advertising. Bigger companies, like Hewlett-Packard or IBM, are looking at the issue more in the long term; but even there, the individual departments always need to hire somebody this week.

"There are a lot of very sane people who are beginning to understand that if technology and science are going to go forward with wild creativity, we need the brilliance of more than a narrow group of people."

The good side of it is that there are lots of opportunities, lots of jobs, in spite of economic ups and downs. Our society is dependent on technology. Also, there are many, many, programs that are trying to get girls and women involved—and to support them when they are involved. All of these programs are starting to get connected. There are a lot of very sane people who are beginning to understand that if technology and science are going to go forward with wild creativity, we need the brilliance of more than a narrow group of people. We need women—all kinds of women.

Several years ago, a colleague and I wondered what would happen if we got a group of the most senior women in computer science together, and just found out what they thought. We didn't actually know what they thought about technology, or policy or education. We didn't have a clue, though a few of us rabble-rousers had talked to each other about issues. We didn't think that they'd just come up with an idea for another gadget! So prior to the annual Grace Hopper conference, we convened a summit of about 50 women from industry, academia, some from government and a few from outside the United States. Rather than a gadget, they agreed there should be a grand challenge for this country's technological community but the challenge should not be technological—the fastest, the smallest, the biggest, whatever. It should be based on social needs. And they decided that international literacy in the broadest sense should be a challenge to the computing community—a government funded, major push for research to figure out how to use technology for universal literacy.

In the past the grand challenges of computing have been technology driven. These women drove it entirely differently. I am proud and excited by the women who are already in computer science and have faith that women will make incredible changes to technology and to

the world. We must change the image so that young women try it out, sampling the reality of education and work so that they can change the world.

SHIRLEY MALCOM, a former high school science teacher and university faculty member, heads the American Association for the Advancement of Science (AAAS) Directorate for Education and Human Resources Programs. She earned her Ph.D. in ecology and was a member of the National Science Board and the President's Committee of Advisors on Science and Technology.

I see two sorts of major deterrents for women in science. First, there are the ones that we basically do to ourselves. I still see a certain amount of anti-science feeling among a lot of women, an anti-technology stance. Perhaps it is looking at the problems and challenges of technology and not seeing that it also brings a lot of solutions—and not understanding that you've got to be in the boat in order to steer it. Women sometimes opt out of course work because of discouraging comments that will go to girls who are taking certain kinds of classes in mathematics and science. Then we are our own enemies. Second, you have the barriers where the enemy

"You've got to be in the boat in order to steer it."

is on the other side—the acts of pure prejudice because of a disbelief that women and girls are valuable and can do the work. You still have these people around. And there are the sins of omission: basically declaring that everything is fine and we don't have to worry about bias anymore—usually in the absence of data.

But we have made great progress. That's one of the things too: we don't celebrate the progress that we have made. Mostly the numbers are up, even though they are not, in many cases, where they need to be. Where the numbers are going in the wrong direction, in computer science, for example, the problem is very much the nature of the culture of the fields as they have become "nerdified." I mean perfectly good fields become nerdified; and that attracts more nerds, and finally there are more nerds around than the regular people who are supposed to be there.

There are particular problems for African-American women and men, because on top of a lot of the cultural issues, you also have real problems about how resources are distributed—the good schools, the good teachers. Even in places like DC, where you have well-off and poor people in the same system, you have situations where some schools are better than others because of the socio-economic level of the people who attend. The parents are more involved; in some cases they raise extra money. So everyone is not getting the same education. And where teachers have a choice, they opt to go into the well-off

schools as opposed to going into poorer neighborhoods.

One program that consumes me right now addresses the problem of school equity. It's a systemic reform undertaken by the AAAS, together with the Carnegie Institution of Washington and the Washington, DC, Public Schools. We're not tackling the entire system. We're focusing on a couple of feeder patterns—high schools and middle schools that feed them. By systemic we mean that we're not just talking about training the teachers, we're talking about the way the schools are organized, the way that leadership expresses itself within the schools, the way that teachers are evaluated by principals, whether they are given tools, skills, and research-validated materials that they can use, how issues of parents and community are dealt with.

The program has to be systemic, because we know how to change a school. We get that done over and over again. But it's not clear that we understand how to change a system. Reform is more complicated in DC, because in New York, for example, forces within the city determine what happens. In DC, the school budget is part of a national budget passed by

"A lot of people are saying why don't science departments feel responsibility toward their students? Why is there the attitude of weeding instead of cultivating?"

Congress, although the chair of the committee for the District of Columbia now is Congresswoman Connie Morella, and she is likely to be sensitive to all the issues that we desperately care about—improving education and making sure there is fair and equitable access. If the only thing I had to do was go in and teach a course, or work with one school, it would be a great luxury. When pieces of the whole system are moving about, you have to measure and anticipate in order to avoid unintended consequences. If you push this, what will happen in that other area? This is not an experiment in a lab. These are real live breathing human beings, and the level of responsibility you feel, or ought to feel if you have any sense, can be overwhelming at times.

When the government spends money on education or scientific research, we have to go back to first principles. I was just reading an official directive on the relationship between the federal government and university research, and it stated such principles: that research is an investment in the future, that research and education must be integrated. National policy dictates that, in teaching a science and engineering workforce, it is vital to link education and

research. So when the government invests in a piece of research, it isn't to support some scientist's pet project. It's to support the integration of research and education and train the nation's workforce. There has been a problem when you have faculty referring to my money, my grant, when it is work that is being done at the behest of the public of the United States on behalf of the public.

So I think that we have to get back to first principles and carry forward with these workforce and human resource issues in the context of doing this work. A lot of people are saying why don't science departments feel responsibility toward their students? Why is there the attitude of weeding instead of cultivating? There are a lot of these concerns that arise once we go down this road.

"We have built a whole system on the basis of family structures that exist only in fairy tales and 1950s TV."

It calls for the golden rule: Them that has the gold makes the rules. You can in fact say, you have to tell me what you're doing. Don't list all 37 publications that you have. I only want to hear about your most important five. And who are the students that you educate? If you have responsibility for a given number of students, what are their names? What do they look like? What are they doing? I do think that there is a lot more that can be done to hold people accountable for what it is that they're supposed to be doing.

There's another situation I'm concerned about. We have built a whole system on the basis of family structures that exist only in fairy tales and 1950s TV. I was at a conference Harvard sponsored here in this building on basic research in the service of public objectives. At some point Ralph Gomory—president of the Sloan Foundation, which has been very involved in searching for structural change—observed that increasingly, among those involved in research science, dual career families consist of scientists married to scientists. My husband is a scientist. Most of the women around here who are married—their husbands are scientists. A dual career couple ends up with three jobs: his job, her job and their job, which is often her job—maintaining the family and the home. And you can't get three jobs out of two people easily. You have no recognition of the need for adequate child care or other kinds of responses to family life and career issues. Perhaps it is that underneath we think that maybe she should be at home with the kids. If there's a childcare issue, that's her problem—as opposed to the fact that these are all of our children and we've got to figure out how we can provide early care and education for all the three year olds and four year olds. These are policy barriers that apply far beyond the scientific community, but they certainly affect our ability to attract people who are realistic about how much they think they can or cannot handle.

CONCLUDING RECOMMENDATIONS:

A Call for Future Research

BARBARA B. LAZARUS is associate provost for academic affairs at Carnegie Mellon University, where changes in the computer science department have increased prospects for women and improved the department's educational environment for all students. In a recent conversation, the National Council for Research on Women asked her what research priorities she would target for the future to move closer to equity for women in science and engineering and to ensure that the perspectives of all women are available to the science and technology community. She identifies five areas where attention is needed: collection and analysis of disaggregated data, applied research to document institutional transformation, longitudinal studies that track women's experience through different phases of education and work, more studies on the employment experiences of women and an international focus to find out where U.S. women stand and to learn from the experiences in other countries.

It is important that we disaggregate the data. Too often, we make generalizations about "women in science and engineering," even when we know the situation is different for women from different backgrounds. We know too little about the experience of women in the U.S. in groups other than the "dominant subculture."

There must be more work that not only examines—but begins to document—effective institutional transformation. At Carnegie Mellon's School of Computer Science, we have an example of transformation (see *The Undergraduate Experience*, page 59), which was initiated by excellent research and strategic planning. For the last several years, most of us have realized that we cannot just add supplementary programs for girls and women, even if they are very good. We also need to understand how institutions change. The new National Science Foundation ADVANCE awards should help this effort enormously. (See *Academia—Graduate School and Beyond*, pages 78–79 in this report.)

We do far too little longitudinal research. We do not understand enough about women's experiences throughout education and work and how interventions at one stage may impact others. For example, we know early interventions in elementary school may encourage girls to like their science course, but does it encourage them as middle school students to take higher level math? Are high school girls who go to summer science programs more likely to major in science and engineering in college or is their real motivation, perhaps, the example of a parent who is a scientist or engineer? We do a lot of work

"We have a terrible tendency to generalize about women around the world based on our own experiences."

trying to help women survive and thrive in their doctoral work, but we do not know whether or how anything that we've done might affect behavior in the labor market, either in universities or industry. For example, we know that many women Ph.D.s do not want to continue to teach in the academy, and we also lose a lot of women in industry. But are they more likely to stay with science and engineering careers if they have been through the support programs we offer during graduate school? It's very hard to do good strategic planning when we have almost no data on factors that carry over time.

We need to do a lot more work that focuses on employment experiences. We are just beginning to learn enough about worksites, academic or industrial, to be able to make some sensible conjectures about what's helpful and what isn't. We need to understand a lot more before we can tease out some of the subtleties of how women's work experiences are impacted by differences in the worksite.

We have a terrible tendency to generalize about women around the world based on our own experiences. Too often, we assume we are "better" than any place else, when in fact, our numbers and percentages often lag behind others. We all know that Smith College recently set up a very exciting engineering department for its women students. But how many of us know that about six years ago, Ewha Women's University, in Seoul, Korea—the largest women's university in the world—established an engineering college for women? How many of us know that 40% of the undergraduate engineers in Puerto Rico are women?

A couple of years ago, I was in Japan interviewing women scientists and engineers. I started out with an assumption about the role of math in keeping women out of engineering careers, because we know that girls are discouraged in the U.S. where too often math is considered not only gendered male but innate in a funny way. We assume everybody can learn to read but not everybody can learn to do Algebra II, and we give up on people very easily. When I referred to the math problem in Japan, nobody could figure out what I was talking about. All Japanese high school graduates take math through calculus. Nobody could fathom the notion that if learning higher math didn't come easily, you weren't supposed to continue. You were supposed to work harder. It became clear that Japanese women had very different career opportunities than men, but it had nothing to do with some concept of a math gene.

Explaining to educators here about my experience in Japan has opened up opportunities for conversations. It allows people to say, "I haven't thought about this. We have multiple ways to teach people how to read, but we don't have multiple ways to teach people basic math facts." We have a tremendous amount to learn from the experiences of most of the world.

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Women's Technology Cluster. http://www.womenstechcluster.org (retrieved May 22, 2001).

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PART 6

Resource Guide

This Resource Guide contains information on programs, projects, research, publications and funding sources for women and girls in science, engineering and technology. The information is divided into three sections: a Directory of Resources broadly categorized by areas of relevance, a more detailed description of programs offered by our member centers or their host institutions entitled Science and Technology Programs of NCRW Member Centers, and an alphabetical listing of all the organizations and websites listed in the Resource Guide. The member center descriptions are organized by state, and we have used NCRW in the directory listings to indicate which programs are more fully described in the second section.

The information contained in this guide aims to give readers an overview of the range of resources available. While care has been taken to provide accurate website links, these change rapidly. In most cases, a quick search on the institution's home page will supply the most current web addresses.

Contact information is provided for all the programs and organizations listed in the guide. Readers will notice that some conferences, projects and research initiatives may not be continuing programs. They have been included as resources because many will have conference papers, reports and documents that may be of help to those seeking to initiate similar programs.

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A. DIRECTORY OF RESOURCES

The organizations listed in this section provide a wide range of information about various fields of the sciences, including current research issues in education and industry, grants and fellowships, associations and conferences.

GENERAL INFORMATION RESOURCES

Advocates for Women in Science, Engineering & Mathematics (AWSEM)
20000 NW Walker Road
Beaverton, OR 97006
PHONE: (503) 748-1504
EMAIL: info@awsem.org
WEBSITES: http://www.awsem.com and http://www.awsem.org

American Association for the Advancement of Science (AAAS)
1200 New York Avenue NW,
Washington, DC 20005
PHONE: (202) 326-6400
WEBSITE: http://www.aaas.org

Association for Women in Science (AWIS)
1200 New York Avenue, Suite 650
Washington, DC 20005
PHONE: (202) 326-8940
WEBSITE: http://www.awis.org

National Science Foundation
4201 Wilson Boulevard
Arlington, VA 22230
PHONE: (703) 292-5111 *or*
(800) 877-8339
WEBSITE: http://www.nsf.gov

Women in Engineering Programs and Advocates Network (WEPAN)
1284 CIVL Bldg. Room G167
West Lafayette, IN 47907-1284
PHONE: (765) 494-5387
fax (765) 494-9152
EMAIL: wiep@ecn.purdue.edu
WEBSITE: http://www.wepan.org

Women in Global Science and Technology Network
623 Brimley Road
Grafton, Ontario, K0K 2G0 Canada
PHONE: (905) 349-9962
WEBSITE: http://www.wigsat.org

RESOURCES FOR K–12 EDUCATION

In-School and After-School Programs

Ameritech Electronic University School Classroom [redacted]
Kent State University
412 White Hall
Kent, OH 44242-0001
PHONE: (330) 672-5835

Saturday Academy
Advocates for Women in Science, Engineering & Math (AWSEM)
20000 NW Walker Road
Beaverton, OR 97006
PHONE: (503) 748-1504
EMAIL: info@awsem.org
WEBSITE: http://www.awsem.com/saturday.html

CyberSisters
P.O. Box 1518
2300 Leo Harris Parkway
Eugene, OR 97440
PHONE: (541) 682-7884
WEBSITE: http://www.cyber-sisters.org

Design it! [redacted]
Wellesley College
Wellesley Centers for Women
Center for Research on Women
106 Central Street
Wellesley, MA 02481
PHONE: (781) 283-2500
WEBSITE: http://www.wellesley.edu/WCW/CRW/SAC/designit.html

Design Your Future: Math, Science and Technology for Girls (DYF)
Autodesk, Inc.
111 McInnis Parkway
San Rafael, CA 94903
PHONE: (800) 538-6401
WEBSITE: http://www.autodesk.com/dyf/dyfmain2.html

Douglass Project for Rutgers Women in Math, Science and Engineering [redacted]
Douglass College, Rutgers
The State University of New Jersey
50 Bishop Street
New Brunswick, NJ 08901-8530
PHONE: (732) 932-9197
WEBSITE: http://www-rci.rutgers.edu/~dougproj

Encouraging the Exploration of Engineering, a Women's Initiative for Schools
Massachusetts Institute of Technology
77 Massachusetts Avenue
Cambridge, MA 02139
PHONE: (617) 253-1000
WEBSITE: http://hkn.mit.edu/act women.html

Expanding Your Horizons (EYH)
The Center for Research on Parallel Computation
Rice University, CRPC–MS 41
6100 Main Street
Houston, TX 77005-1892
PHONE: (713) 527-6077
WEBSITES: http://www.crpc.rice.edu/CRPC/education and http://www.crpc.rice.edu/CRPC/Women/EYH

Expanding Your Horizons in Science, Mathematics and Engineering
WISE Institute
The Pennsylvania State University
111 Kern Building
University Park, PA 16802
PHONE: (814) 865-3342
WEBSITE: http://www.psu.edu/dept/wise

Future Science: Future Engineering NEW!
University of Michigan, Women in Science and Engineering Program (WISE)
1065 Frieze Building
105 S. State Street
Ann Arbor, MI 48109-1285
PHONE: (734) 615-4455
WEBSITE: http://www.umich.edu/~umwise

Girls and Women in Science (GWIS) NEW!
Hamilton College
The Kirkland Project for the Study of Gender, Society and Culture
198 College Hill Road
Clinton, NY 10005
PHONE: (315) 859-4149 or 859-4288
WEBSITE: http://academics.hamilton.edu/organizations/kirkland

Girls Dig It℠: An Archeology Program for Girls 12 to 14 NEW!
Girls Incorporated
441 West Michigan Street
Indianapolis, IN 46202-3233
PHONE: (800) 374-4475 or (317) 634-7546
WEBSITE: http://www.girlsinc.org

Girls in the SYSTEM NEW!
University of Arizona, Southwest Institute for Research on Women
Women in Science and Engineering Program in collaboration with the Tucson Sahauro Girl Scout Council
Communication 108, Box 210025
Tucson, AZ 85721
PHONE: (520) 621-7338
WEBSITE: http://gistem.math.arizona.edu

High School Mentoring Program Expanding Your Horizons Conference NEW!
The University of Arizona
Southwest Institute for Research on Women, Women in Science and Engineering Program
Communication 108, Box 210025
Tucson, AZ 85721
PHONE: (520) 621-7338
WEBSITE: http://w3.arizona.edu/~ws

I.M.A.G.I.N.E. Program, Sophie B. Wired Computer Cluster Project NEW!
Tulane University, Newcomb College Center for Research on Women
New Orleans, LA 70118
PHONE: (504) 865-5238
WEBSITE: http://www.tulane.edu/~wc

Operation SMART NEW!
Girls Incorporated
441 West Michigan Street
Indianapolis, IN 46202-3233
PHONE: (800) 374-4475 or (317) 634-7546
WEBSITE: http://www.girlsinc.org/programs/smart.html

Plugged In
2115 University Avenue
East Palo Alto, CA 94303-2224
PHONE: (650) 322-1134
WEBSITE: http://www.pluggedin.org

Project GOLD (Girls On-Line with Disabilities) NEW!
University of Minnesota
128 Pleasant Street SE
Minneapolis, MN 55455
PHONE: (612) 625-3398
WEBSITE: http://www.disserv.stu.umn.edu/gold

Pre-College Recruitment
Purdue University
Women in Engineering Program
1284 Civil Engineering Building
Room G167
West Lafayette, IN 47907-1284
PHONE: (765) 494-3889
WEBSITE: http://fairway.ecn.purdue.edu/~wiep

Schoolnet Classrooms NEW!
Kent State University
P.O. Box 5190
Kent, OH 44242-0001
PHONE: (330) 672-5835

Student Challenge Awards Program
Earthwatch Institute
Center for Field Research
3 Clocktower Place
Suite 100, Box 75
Maynard, MA 01754
PHONE: (978) 461-0081
FAX: (978) 461-2332
WEBSITE: http://www.earthwatch.org/cfr/CFRdurfee.html

Take Our Daughters to Work Program
Ms. Foundation for Women
120 Wall Street
New York, NY 10005
PHONE: (212) 742-2300
WEBSITE: http://www.takeourdaughterstowork.org

TechGYRLS NEW!
Young Women's Christian Association of the USA (YWCA)
350 5th Avenue, Suite 301
New York, NY 10118
PHONE: (212) 273-7800
WEBSITE: http://www.ywca.org

Using Math—Girls Investigate Real Life (U-M Girl) NEW!
University of Michigan
Institute for Research on Women
460 West Hall
Ann Arbor, MI 48109
PHONE: (734) 764-9537
WEBSITE: http://www.umich.edu/~irwg/index.html

WISE Math Day
WISE Institute
The Pennsylvania State University
111 Kern Building
University Park, PA 16802
PHONE: (814) 865-3342
WEBSITE: http://www.psu.edu/dept/wise

Young Women's Technology Cluster
1207 Indiana Street, #1
San Francisco, CA 94107

Summer Programs for Girls

Discover Engineering Summer Camp (DESC)
Ryerson Polytechnic University
Women in Engineering
350 Victoria Street
Toronto, Ontario, M5B 2K3, Canada
PHONE: (416) 979-5000 ext. 7220
WEBSITE: http://www.ee.ryerson.ca:8080/~womeng

Environmental Science Camp for Girls
Wave Hill
675 West 252nd Street
Bronx, NY 10471-2899
PHONE: (718) 549-3200 ext. 222
FAX: (718) 884-8952
EMAIL: education@wavehill.org
WEBSITE: http://www.wavehill.org/

***Eureka!*™ A component of Girls Incorporated® Operation SMART℠** NEW!
Girls Incorporated
441 West Michigan Street
Indianapolis, IN 46202-3233
PHONE: (800) 374-4475 *or* (317) 634-7546
WEBSITE: http://www.girlsinc.org

GenderWise Working Conference NEW!
Mt. Holyoke College
Five College Women's Studies Research Center, Dickinson House
South Hadley, MA 01075
PHONE: (413) 538-2275
FAX: (413) 538-2082

Get Wired, Get Hired
Bentley College
175 Forest Street
Waltham, MA 02452-04705
PHONE: (781) 891-2244
WEBSITE: http://www.bentley.edu/camp/wired

Girlstart Summer and Saturday Camps
Girlstart
608 West 22nd Street
Austin, TX 78705
PHONE: (512) 916-4775
WEBSITE: http://www.girlstart.org

International Paper Math and Science Scholars Summer Workshop NEW!
Marymount Institute for the Education of Women & Girls
Marymount College, Box 1173
100 Marymount Avenue
Tarrytown, NY 10591-3796
PHONE: (914) 332-8291
WEBSITE: http://www.marymt.edu/~summsci

Smith Summer Science and Engineering Program NEW!
Clark Science Center, Smith College
Northampton, MA 01063
PHONE: (413) 585-3060
EMAIL: info@summerscience.smith.edu
WEBSITE: http://smith.escapecs.com/

SummerMath NEW!
Mount Holyoke College
50 College Street
South Hadley, MA 01075-1441
PHONE: (413) 538-2608
FAX: (413) 538-2002
WEBSITE: http://www.mtholyoke.edu/proj/summermath/

Summer Program in Science, Mathematics and Technology (STEP)
Settlement College Readiness Program
1775 Third Avenue
New York, NY 10029
PHONE: (212) 828-6138

Science and Technology Entry Program (STEP)
St. John's University
Office of Special Programs
8000 Utopia Parkway
Jamaica, NY 11439
PHONE: (718) 990-6565
WEBSITE: http://www.stjohns.edu/academics/special_opps/index.html

Women in the Sciences & Engineering (WISE) Week
WISE Institute
The Pennsylvania State University
111 Kern Building
University Park, PA 16802
PHONE: (814) 865-3342
WEBSITE: http://www.psu.edu/dept/wise

Professional Development for Teachers

The Clare Boothe Luce Program
Henry Luce Foundation
111 West 50th Street
New York, NY 10020
PHONE: (212) 489-7700
WEBSITE: http://www.hluce.org/index.html

Eleanor Roosevelt Teacher Fellowships NEW!
American Association of University Women (AAUW)
Educational Foundation
1111 Sixteenth Street NW
Washington DC 20036
PHONE: (202) 728-7613 or (800) 326-AAUW
WEBSITE: http://www.aauw.org/3000/fdnfelgra/ertf.html

Girls Count
225 East 16th Avenue, #47
Denver, CO 80203
PHONE: (303) 832-6600
FAX: (303) 832-7331
WEBSITE: http://www.girlscount.org

GirlTECH '00
Rice University,
Center for Excellence and Equity in Education
6100 Main Street
Houston, TX 77005
Phone (713) 348-6122
WEBSITE: http://www.crpc.rice.edu/CRPC/Women/GirlTECH

Linking The Future To The Present Project NEW!
Part of the national PT3 (Preparing Tomorrow's Teachers To Use Technology) initiative
Kent State University
P.O. Box 5190
Kent, OH 44242-0001
PHONE: (330) 672-5835

Professional Development Workshops for Teachers
Wave Hill
675 West 252nd Street
Bronx, NY 10471-2899
PHONE: (718) 549-3200 ext. 222
FAX: (718) 884-8952
EMAIL: education@wavehill.org
WEBSITE: http://www.wavehill.org/

Smith College Summer Institute for Educators NEW!
Clark Science Center, Smith College
Northampton, MA 01063
PHONE: (413) 585-3060
WEBSITE: http://www.smith.edu/summerprograms/educators

SummerMath for Teachers NEW!
Mount Holyoke College
50 College Street
South Hadley, MA 01075-1441
PHONE: (413) 538-2608
FAX: (413) 538-2002
WEBSITE: http://www.mtholyoke.edu/proj/smt/index.html

Summer Seminar on Gender Issues NEW!
Wellesley College, Wellesley Centers for Women, Center for Research on Women Stone Center for Developmental Services and Studies
106 Central Street
Wellesley, MA 02481
PHONE: (781) 283-2500
WEBSITE: http://www.wellesley.edu/wcw/index.html

WEEA Equity Resource Center
EDC
55 Chapel Street
Newton, MA 02458-1060
PHONE: (800) 225-3088 or (617) 969-7100
FAX: 617-332-4318
EMAIL: WEEActr@edc.org
WEBSITE: http://www.edc.org/WomensEquity/about.htm

Research, Curriculum Development and Assessment Programs for K–12

Educating Girls: New Issues in Science and Technology Education NEW!
University of California, Los Angeles,
Center for the Study of Women
288 Kinsey Hall
Los Angeles, CA 90095
PHONE: (310) 825-0590
WEBSITE: http://women.ucla.edu/csw/index.html

Math, Science, and Technology Programs for Girls NEW!
American Association of University Women (AAUW)
Educational Foundation
1111 Sixteenth Street NW
Washington DC 20036
PHONE: (202) 728-7613
WEBSITE: http://www.aauw.org/2000/models.html

Marymount Institute for the Education of Women & Girls NEW!
Marymount College Tarrytown
100 Marymount Avenue
Tarrytown, NY 10591-3796
PHONE: (914) 332-4917
WEBSITES: http://www.marymt.edu/~wominst and http://www.marymt.edu/~dome/women.html

National Institution for Science Education NEW!
University of Wisconsin, Madison
1025 West Johnson Street
Madison, WI 53706
PHONE: (608) 263-9250
WEBSITE: http://www.wcer.wisc.edu/nise/About_nise

National Science Resources Center (NSRC)
955 L'Enfant Plaza SW, Suite 8400
Washington DC 20560-0952
PHONE: (202) 287-2063
WEBSITE: http://www.si.edu/nsrc/about/about.htm

Research Center For Educational Technology (RCET) WOMEN
Kent State University
412 White Hall
Kent, OH 44242-0001
PHONE: (330) 672-5835
WEBSITE: http://www.rcet.org

Rural Girls in Science WOMEN
University of Washington, Northwest Center for Research on Women
Imogene Cunningham Hall
Box 351380
Seattle, WA 98195
PHONE: (206) 543-9531
WEBSITE: http://depts.washington.edu/rural/RURAL

Society for Advancement of Chicanos and Native Americans in Science
SACNAS
P.O. Box 8526
Santa Cruz, CA 95061-8526
PHONE: (831) 459-0170
WEBSITE: http://www.sacnas.org

Tech Check Database of Model Schools WOMEN
American Association of University Women (AAUW)
Educational Foundation
1111 Sixteenth Street NW
Washington DC 20036
PHONE: (202) 728-7613
WEBSITE: http://www.aauw.org/2000/techchk.html

The Voices Project
Appalachia Educational Laboratory (AEL)
P.O. Box 1348
Charleston, WV 25325-1348
PHONE: (800) 624-9120 *or* (304) 347-0400
WEBSITE: http://www.ael.org/nsf/voices/index.htm

WEEA Equity Resource Center
EDC
55 Chapel Street
Newton, MA 02458-1060
PHONE: (800) 225-3088 *or* (617) 969-7100
FAX: 617-332-4318
EMAIL: WEEActr@edc.org
WEBSITE: http://www.edc.org/WomensEquity/about.htm

Women's Research and Education Institute (WREI) WOMEN
1750 New York Avenue, Suite 350
Washington DC 20009
PHONE: (202) 628-0444
WEBSITE: http://www.wrei.org

Online Resources for K–12

The Archives of Women in Science and Engineering
Iowa State University
WEBSITE: http://www.lib.iastate.edu/spcl/wise/k12.html

Backyard Camp
Backyard Project
WEBSITE: http://www.backyard.org

Cascade Pass
WEBSITE: http://www.cascadepass.com

Changing Channels
WEBSITE: http://www.channels.org

Eisenhower National Clearinghouse
WEBSITE: http://www.enc.org

Equity Online (WEEA) Education Development Center, Inc. (EDC)
WEBSITE: http://www.edc.org/WomensEquity

Expect the Best From a Girl
WEBSITE: http://www.academic.org

Girls and Women in Science at Beloit College
WEBSITE: www.beloit.edu/~gwsci/gws.html

Girls Count
WEBSITE: http://www.girlscount.org

Girl Scouts of the USA – Just for Girls Website
WEBSITE: http://jfg.girlscouts.org

GirlStart
WEBSITE: http://www.girlstart.com

Girltech
WEBSITE: www.girltech.com

Helping Your Child Learn Science (U.S Department of Education)
WEBSITE: http://www.ed.gov/pubs/parents/Science/index.html

Math/Science Network
WEBSITE:www.expandingyourhorizons.org

Plugged In
WEBSITE: http://www.plugged-in.org

Research Information Network (RIN) For Women and Girls in Illinois
WEBSITE: http://www.uic.edu/orgs/rin

Role Model Project for Girls
WEBSITE: http://www.womenswork.org/girls/compsci

TAP Junior
WEBSITE: http://www.cs.yale.edu/homes/tap/tap-junior.html

WEEA Equity Resource Center
WEBSITE: http://www.edc.org/WomensEquity/about.htm

Women of NASA
WEBSITE: http://quest.arc.nasa.gov/women/intro.html

RESOURCES FOR COLLEGE AND UNIVERSITY EDUCATION

Undergraduate Programs

Center for Women's Studies and Gender Research NEW
University of Florida
3324 Turlington Hall
P.O. Box 117350
Gainesville, FL 32611
PHONE: (352) 392-3365
WEBSITE: http://web.wst.ufl.edu/index.html

Center for the Study of Women and Society NEW
City University of New York (CUNY)
365 Fifth Avenue, 5th Floor
New York, NY 10016
PHONE: (212) 817-8895
FAX: (212) 817-8905
WEBSITES: http://web.gc.cuny.edu/womencenter and http://web.gc.cuny.edu/womenstudies/

College of Engineering
Carnegie Mellon University
Pittsburgh, PA 15213
PHONE: (412) 268-2481
WEBSITE: http://www.cit.cmu.edu/

Diversity Works NEW
Association of American Colleges and Universities, Project on the Status and Education of Women
1818 R Street NW
Washington DC 20009
PHONE: (202) 387-3760
WEBSITE: http://www.aacu-edu.org/Initiatives/diversity.html

Douglass Project for Rutgers Women in Science, Math and Engineering NEW
Douglass College, Rutgers
The State University of New Jersey
50 Bishop Street
New Brunswick, NJ 08901-8530
PHONE: (732) 932-9197
WEBSITE: http://www-rci-rutgers.edu/~dougproj

The Feminist Press NEW
365 Fifth Avenue, 5th Floor
New York, NY 10016
PHONE: (212) 817-7920
FAX: (212) 987-4008
WEBSITE: http://www.feministpress.org

Five College Women's Studies Research Center NEW
Mount Holyoke College
Dickinson House
South Hadley, MA 01075
PHONE: (413) 538-2275
FAX: (413) 538-2082
WEBSITE: http://www.mtholyoke.edu

Futurebound: Increasing the Participation of Women and Minorities in Engineering NEW
University of Arizona
Southwest Institute for Research on Women, Women in Science and Engineering Program in collaboration with UA Engineering Multicultural Engineering Program and PIMA West Community College
Communication 108, Box 210025
Tucson, AZ 85721
PHONE: (520) 621-7338
WEBSITE: http://w3.arizona.edu/~ws/newweb/wsl/coverpage.html

Gender and Science NEW
Ohio State University
Department of Women's Studies
286 University Hall
230 North Oval Mall
Columbus, OH 43210
PHONE: (614) 292-1021
WEBSITE: http://www.cohums.ohio-state.edu/wost

Laura P. Meyer Internship NEW
Loyola University Chicago
The Gannon Center, Women in Science Enabling Research (WISER)
6525 North Sheridan Road
Sullivan 20
Chicago, IL 60626
PHONE: (773) 508-8430
WEBSITE: http://www.luc.edu/orgs/gannon/wiser

Mellon College of Science
Carnegie Mellon University
5000 Forbes Avenue
Pittsburgh, PA 15213-3890
PHONE: (412) 268-2082
FAX: (412) 268-7838
EMAIL: undergraduate-admissions@andrew.cmu.edu
WEBSITE: http://www.cmu.edu/mcs

Minorities in Marine Science Undergraduate Program (MIMSUP)
Shannon Point Marine Center
1900 Shannon Point Road
Anacortes, WA 98221
PHONE: (360) 293-2188
WEBSITE: http://www.wwu.edu/~mimsup

Picker Program in Engineering and Technology NEW
Smith College
Picker Engineering Program
Northampton, MA 01063
PHONE: (413) 585-7000
WEBSITE: http://www.science.smith.edu/departments/Engin

Summer Research Programs in Computing for Women and Minorities
The Center for Research
on Parallel Computation (CRPC)
CRPC 217-50, Caltech
Pasadena, CA 91125
PHONE: (713) 348-6077
WEBSITE: http://www.ama.caltech.edu/~joann/crpc/sugp97.html

Women's Studies WOMEN
Duke University,
210 East Duke Building, Box 90760
Durham, NC 27708
PHONE: (919) 684-5683
FAX: (919) 684-4652
EMAIL: wstprog@duke.edu
WEBSITE: www.duke.edu/womstud

WISE, WISER, WIE, WICS, WESP, WIEP

Programs are available at many colleges and universities, although they are not necessarily linked. Programs may vary by campus and may include mentoring programs, lecture series, clubs, outreach programs and career training. Some programs also have resources for graduate students. Following is a sample of programs. See the WEPAN website for additional listings.

WEBSITE: http://www.wepan.org

Women in Computer Science (WICS):
Stanford University WOMEN
Computer Science Department
353 Serra Mall
Stanford, CA 94305
PHONE: (650) 723-2273
WEBSITE: http://www-cs-students.stanford.edu/~womencs

University of California, Irvine
Information and Computer Science
444 Computer Science Building
Irvine, CA 92697
Phone (949) 824-7403
WEBSITE: http://www.ics.uci.edu/~wics

Women in Engineering (WIE):
Ryerson Polytechnic University
350 Victoria Street, Toronto
Ontario, M5B 2K3, Canada
PHONE: (416) 979-5000 ext. 7220
WEBSITE: http://www.ee.ryerson.ca:8080/~womeng

University of California, Davis WOMEN
College of Engineering
1 Shields Avenue
Davis, CA 95616
PHONE: (530) 752-INFO
WEBSITE: http://wie.ucdavis.edu

Women in Engineering and Science Program (WESP):
Kansas State University
125 Seton Hall
Manhattan, KS 66506-2905
PHONE: (785) 532-3395
WEBSITE: http://www.ksu.edu/wesp

Women in Engineering Program (WIEP):
Purdue University
1284 Civil Engineering Building
Room G167
West Lafayette, IN 47907-1284
PHONE: (765) 494-3889
WEBSITE: http://fairway.ecn.purdue.edu/~wiep

Women in Mathematics (WIM):
University of Maryland WOMEN
College Park
4114 Computer &
Space Sciences Building
College Park, MD 20742
PHONE: (301) 405-7892
WEBSITE: http://www.awm-math.org

Women In Science and Engineering (WISE):
Brown University WOMEN
Mailbox 1939
Providence, RI 02912
PHONE: (401) 863-2314
WEBSITE: http://www.brown.edu/Student_Services/WiSE/index.html

The Caltech Women Center
Women's Center Cottage
355 S. Holliston, Mail Code: 094
Pasadena, CA 91125
PHONE: (626) 395-3221
WEBSITE: http://www.cco.caltech.edu/~wcenter

Dartmouth College
Women in Science Project
8000 Cummings Hall
Hanover, NH 03755
Phone (603) 646-3690
WEBSITE: http://www.dartmouth.edu/~wisp/home.html

Douglass College WOMEN
Rutgers
The State University of New Jersey
50 Bishop Street
New Brunswick, NJ 08901-8530
PHONE: (732) 932-9197
WEBSITE: http://www.rci.rutgers.edu/~dougproj

Purdue University
Women in Science Program
1390 Mathematical Sciences
West Lafayette, IN 47907
PHONE: (765) 494-1771
WEBSITE: http://www.science.purdue. edu/wisp

University of Arizona WOMEN
Southwest Institute for
Research on Women
Women's Studies
Tucson, AZ 85721
PHONE: (520) 621-7338
WEBSITES: http://w3.arizona.edu/~ws/newweb/wise.html and http://w3.arizona.edu/~ws/newweb/sirow.html

University of Calgary
MacEwan Hall Box 757
2500 University Drive NW
Calgary, Alberta, T2N 1N4, Canada
PHONE: (403) 220-3290
WEBSITE: http://www.ucalgary.ca/~womense

University of Cincinnati NEW!
Center for Women's Studies
P.O. Box 210164
Cincinnati, OH 45221
PHONE: (513) 556-6652
WEBSITE: http://www.ececs.uc.edu/~cpurdy/wisepage.html

University of Michigan, Ann Arbor NEW!
1065 Frieze Building
105 S. State Street
Ann Arbor, MI 48109-1285
PHONE: (734) 615-445
WEBSITE: http://www.umich.edu/~umwise

University of Rochester
Department of Physics & Astronomy,
Bausch & Lomb 208A
Rochester, NY 14627
PHONE: (716) 275-9344
WEBSITE: http://www.pas.rochester.edu/mainFrame/education/special/specialWISE.html

University of Washington NEW!
101 Wilson Annex, Box 352135
Seattle, WA 98195
PHONE: (206) 543-4810
WEBSITE: http://www.engr.washington.edu/~uwwise

Women in Science and Engineering Resource (WISER): Cornell University
280 Clark Hall
Ithaca, NY 14853-2801
WEBSITE: http://www.englib.cornell.edu/wiser/

Graduate Programs

See also Undergraduate Programs for listing of WISE, WICS, WISER, WIE and WESP and other programs that also offer resources to graduate students.

Carnegie Institute of Technology
Carnegie Mellon University
College of Engineering
Pittsburgh, PA 15213
PHONE: (412) 268-2481
WEBSITE: http://www.cit.cmu.edu/

Center for the Study of Women and Society NEW!
City University of New York (CUNY)
365 Fifth Avenue, 5th Floor
New York, NY 10016
PHONE: (212) 817-8895
FAX: (212) 817-8905
WEBSITES: http://web.gc.cuny.edu/womencenter and http://web.gc.cuny.edu/womenstudies/

Center for Women's Studies and Gender Research, University of Florida NEW!
3324 Turlington Hall, P.O. Box 117352
Gainesville, FL 32611
PHONE: (352) 392-3365
WEBSITE: http://web.wst.ufl.edu/index.html

Graduate Experience Project NEW!
University of Michigan, Women in Science and Engineering Program (WISE)
1065 Frieze Building
105 S. State Street
Ann Arbor, MI 48109-1285
PHONE: (734) 615-4455
WEBSITE: http://www.umich.edu/~gep

Mellon College of Science
Carnegie Mellon University
5000 Forbes Avenue
Pittsburgh, PA 15213-3890
PHONE: (412) 268-2082
FAX: (412) 268-7838
WEBSITE: http://www.cmu.edu/mcs

The Noetherian Ring NEW!
University of California, Berkeley,
Department of Mathematics
970 Evans Hall
Berkeley, CA 94720
PHONE: (510) 642-6550
WEBSITE: http://www.math.berkeley.edu/~nring/index.html
This program exists on other campuses as well. See website for links.

Women in the Sciences and Engineering Institute (WISE)
Pennsylvania State University
111 Kern Building
University Park, PA 16802
PHONE: (814) 865-3342
WEBSITE: http://www.personal.psu.edu/dept/wise

Women in Computer Science and Electrical Engineering (WICSE) NEW!
University of California, Berkeley
292 Cory Hall
Berkeley, CA 94720-1770
PHONE: (510) 642-6735
WEBSITE: http://www-inst.eecs.berkeley.edu/~wicse

Research, Curriculum Development and Assessment Programs for Higher Education

Achieving Gender Equity in Science Classrooms: Guide for Faculty NEW!
Brown University
Office of the Dean of the College
Providence, RI 02912
Phone (401) 863-1000
WEBSITE: http://www.brown.edu/Administration/Dean_of_the_College/homepginfo/equity/Equity_handbook.html

Advancing Women's Leadership in Medicine, Health Science and Health Care
Mills College
Women's Leadership Institute
5000 MacArthur Boulevard
Oakland, CA 94613
PHONE: (510) 430-2019
WEBSITE: http://www.mills.edu/WLI/wli.women_medicine.html

Center for Gender Studies
Radford University, Box 6946
Radford, VA 24142
PHONE: (540) 831-6644
WEBSITE: http://www.runet.edu/~gstudies

Committee on Institutional Cooperation (CIC)
University of Illinois at Urbana/Champaign
302 East John Street, Suite 1705
Champaign, IL 61820
PHONE: 217-333-8475
WEBSITE: http://www.cic.uiuc.edu

"The Double Bind Revisited": Women of Color in Math, Science and Engineering
University of California, Los Angeles
Center for the Study of Women
288 Kinsey Hall
Los Angeles, CA 90095
PHONE: (310) 825-0590
WEBSITE: http://women.ucla.edu/csw

Ecological Conversations: Gender, Science, and the Sacred
University of Oregon
Center for Women in Society
1201 University of Oregon
Eugene, OR 97403
PHONE: (541) 346-5399
WEBSITE: http://ecocon.uoregon.edu

The Feminist Press
365 Fifth Avenue, 5th Floor
New York, NY 10016
PHONE: (212) 817-7920
FAX: (212) 987-4008
WEBSITE: http://www.feministpress.org

Marymount Institute for the Education of Women & Girls
Marymount College Tarrytown
100 Marymount Avenue
Tarrytown, NY 10591-4917
PHONE: 914-332-4917
WEBSITES: http://www.marymt.edu/~womninst and http://www.marymt.edu/~dome/women.html

Mellon College of Science Research Centers
Carnegie Mellon University
5000 Forbes Avenue
Pittsburgh, PA 15213-3890
PHONE: (412) 268-2082
FAX: (412) 268-7838
WEBSITE: http://www.cmu.edu/mcs/research/rsch_centers.html

National Institution for Science Education
University of Wisconsin, Madison
1025 West Johnson Street
Madison, WI 53706
PHONE: (608) 263-9250
WEBSITE: http://www.wcer.wisc.edu/nise/About_nise

Science, Society, and Gender
Harvard University, Radcliffe Institute for Advanced Study (RIAS), The Radcliffe Public Policy Center (RPPC)
69 Brattle Street
Cambridge, MA 02138
PHONE: (617) 496-3478
FAX: (617) 496-2982
EMAIL: rppc@harvard.edu
WEBSITE: http://www.radcliffe.edu/pubpol/index.html

Syllabi on the Web for Women and Gender-Related Courses
University of Maryland, Center for Women and Information Technology, UMBC
100 Hilltop Circle
Baltimore, MD 21250
PHONE: (410) 455-2822
WEBSITE: http://www.umbc.edu/cwit/syllabi.html

WEEA Equity Resource Center
EDC
55 Chapel Street
Newton, MA 02458-1060
PHONE: (800) 225-3088 or (617) 969-7100
FAX: 617-332-4318
EMAIL: WEEActr@edc.org
WEBSITE: http://www.edc.org/WomensEquity/about.htm

Women and Scientific Literacy: Building Two-Way Streets
University of Arizona, Southwest Institute for Research on Women
Communication 108, Box 210025
Tucson, AZ 85721
PHONE: (520) 621-7338
WEBSITE: http://w3.arizona.edu/~ws/newweb/wsl/coverpage.html

Online Resources for Higher Education

The Ada Project (TAP)
WEBSITE: http://tap.mills.edu

Chemistry Internet Resource for Research by Undergraduate Students (CIRRUS)
WEBSITE: http://cirrus.chem.plu.edu/

MentorNet
WEBSITE: http://www.mentornet.net

Research Information Network (RIN) For Women and Girls in Illinois
WEBSITE: http://www.uic.edu/orgs/rin

Women and Gender Studies Science and Technology Websites, Association of College and Research Libraries (ACRL) – Women's Studies Section
WEBSITE: http://libraries.mit.edu/humanities/WomensStudies/Tech2.html

Women in Biology Internet Launch Pages
WEBSITE: http://pingu.salk.edu/~forsburg/bio.html

Women in Computer Science NEW!
WEBSITE: http://www.mills.edu/ACAD_INFO/MCS/SPERTUS/Gender/gender.html

RESOURCES FOR PROFESSIONAL DEVELOPMENT

Career Development

A+ Program
University of Maryland, Center for Women and Information Technology, UMBC
100 Hilltop Circle
Baltimore, MD 21250
PHONE: (410) 455-2822
WEBSITES: http://research.umbc.edu/shattuck/a-plus.html and http://oia.umbc.edu/newsevents/index.htm l?news_id=0000000189

Advancing Women's Leadership in Medicine, Health Sciences and Health Care NEW!
Mills College
Women's Leadership Institute
5000 MacArthur Boulevard
Oakland, CA 94613
PHONE: (510) 430-2019
WEBSITE: http://www.mills.edu/WLI/wli.women_medicine.html

AT&T Foundation
AT&T, Room 2417
32 Avenue of the Americas
New York, NY 10013
PHONE: (212) 387-5352
WEBSITE: http://www.att.com/foundation

Catalyst NEW!
120 Wall Street
New York, NY 10005
PHONE: (212) 514-7600
http://www.catalystwomen.org/home.html

Directory of Practitioners
Advocates for Women in Science, Engineering & Mathematics (AWSEM)
20000 NW Walker Road
Beaverton, OR 97006
PHONE: (503) 748-1504
WEBSITE: http://www.awsem.org

GirlGeeks
2325 Third Street, Suite 217
San Francisco, CA 94107-3197
PHONE: (415) 581-0414
WEBSITE: http://www.girlgeeks.com

Institute for Women's Policy Research (IWPR) NEW!
1707 L Street NW, Suite 750
Washington DC 20036
PHONE: (202) 785-5100
FAX: (202) 833-4362
WEBSITE: http://www.iwpr.org

National Institution for Science Education NEW!
University of Wisconsin, Madison
1025 West Johnson Street
Madison, WI 53706
PHONE: (608) 263-9250
WEBSITE: http://www.wcer.wisc.edu/nise/About_nise

National Center For Policy Research For Women & Families (CPR) NEW!
1444 Eye Street NW, Suite 900
Washington DC 20005
PHONE: (202) 216-9507
FAX: (202) 216-9845
WEBSITE: http://www.cpr4womenandfamilies.org

Professional Opportunities for Women in Research and Education (POWRE)
National Science Foundation
4201 Wilson Boulevard
Arlington, VA 22230
PHONE: (703) 292-5111
WEBSITE: http://www.nsf.gov/home/crssprgm/powre/start.htm

Putting the Law on Your Side: A Guide for Women and Girls to Equal NEW!
Opportunity in Career Education and Job Training
National Women's Law Center
11 Dupont Circle, Suite 800
Washington DC 20036
PHONE: (202) 588-5180
WEBSITE: http://nwlc.org

Virtual Development Center
Institute for Women and Technology (IWT)
3333 Coyote Hill Road
Palo Alto, CA 94302
PHONE: (650) 812-4496
WEBSITE: http://www.iwt.org

Research, Programmatic and Institutional Reform

Accessing Global Markets: Women & Minorities in Trade & Technology Project
Global Alliance for Diversifying the Science and Engineering Workforce
1200 New York Avenue NW
Washington DC 20005
PHONE: (202) 326-6670
WEBSITE: http://www.globalalliancesmet.org/wmitt/01home/home.htm

ADVANCE Institutional Transformation Awards, National Science Foundation
EMAIL: advance@nsf.gov
WEBSITE: http://www.nsf.gov

Advancing Women's Leadership in Medicine, Health Sciences and Health Care NEW!
Mills College
Women's Leadership Institute
5000 MacArthur Boulevard
Oakland, CA 94613
PHONE: (510) 430-2019
WEBSITE: http://www.mills.edu/WLI/wli.women_medicine.html

The Center for Women and Work WEBSITE
Douglass Campus, Rutgers
The State University of New Jersey
Ruth Dill Johnson Crockett Building
162 Ryders Lane
New Brunswick, NJ 08901
PHONE: (732) 932-1463
FAX: (732) 932-4739
WEBSITE: http://www.rci.rutgers.edu/~cww/index.html

Ecological Conversations: Gender, Science, and the Sacred WEBSITE
University of Oregon
Center for Women in Society
1201 University of Oregon
Eugene, OR 97402
PHONE: (541) 346-5399
WEBSITE: http://ecocon.uoregon.edu

InGEAR (Integrating Gender Equity and Reform)
Georgia Institute for Technology
CEISMC
500 Tech Parkway
Atlanta, GA 30332-0282
PHONE: (404) 894-9673
FAX: (404) 894-9675
WEBSITE: http://www.ceismc.gatech.edu/ceismc/programs/ingear/homepg.htm

Institute for Women and Technology (IWT)
3333 Coyote Hill Road
Palo Alto, CA 94302
PHONE: (650) 812-4496
WEBSITE: http://www.iwt.org

Marymount Institute for the Education of Women and Girls WEBSITE
Marymount College Tarrytown
100 Marymount Avenue
Tarrytown, NY 10591-4917
PHONE: (914) 332-4917
WEBSITES: http://www.marymt.edu/~wominst and http://www.marymt.edu/~dome/women.html

National Center For Policy Research For Women & Families (CPR) WEBSITE
1444 Eye Street, NW, Suite 900
Washington DC 20005
PHONE: (202) 216-9507
FAX: (202) 216-9845
WEBSITE: http://www.cpr4womenandfamilies.org

Professional Pathways: Examining Work, Family, and Community in the Biotechnology Industry WEBSITE
Harvard University, Radcliffe Institute for Advanced Study (RIAS)
The Radcliffe Public Policy Center (RPPC)
69 Brattle Street
Cambridge, MA 02138;
PHONE: (617) 496-3478
FAX: (617) 496-2982
EMAIL: rppc@harvard.edu
WEBSITE: http://www.radcliffe.edu/pubpol/index.html

Program for Gender Equity in Science, Mathematics and Technology
National Science Foundation
4201 Wilson Boulevard
Arlington, VA 22230
PHONE: (703) 292-5111 or (800) 877-8339
WEBSITE: http://www.nsf.gov

Student Challenge Awards Program
Earthwatch Institute
Center for Field Research
3 Clocktower Place
Suite 100, Box 75
Maynard, MA 01754
PHONE: (978) 461-0081
FAX: (978) 461 2332
WEBSITE: http://www.earthwatch.org/cfr/CFRdurfee.html

WEEA Equity Resource Center
EDC
55 Chapel Street
Newton, MA 02458-1060
PHONE: (800) 225-3088 or (617) 969-7100
FAX: (617) 332-4318
EMAIL: WEEActr@edc.org
WEBSITE: http://www.edc.org/WomensEquity/about.htm

Women in Information Technology Workplaces: A Study of Women WEBSITE
Computer Science Degree Recipients in the Software Industry
Harvard University, Radcliffe Institute for Advanced Study (RIAS)
The Radcliffe Public Policy Center (RPPC)
69 Brattle Street
Cambridge, MA 02138
PHONE: (617) 496-3478
FAX: (617) 496-2982
EMAIL: rppc@harvard.edu
WEBSITE: http://www.radcliffe.edu/pubpol/index.html

Women in the Information Age WEBSITE
Harvard University, John F. Kennedy School of Government, Women and Public Policy Program
79 John F. Kennedy Street
Cambridge, MA 02138
PHONE: (617) 496-6973
FAX: (617) 496-6154
EMAIL: wappp@ksg.harvard.edu
WEBSITE: http://www.ksg.harvard.edu/wappp

National Associations

American Association for the Advancement of Science (AAAS)
1200 New York Avenue NW
Washington DC 20005
PHONE: (202) 326-6400
WEBSITE: http://www.aaas.org

American Association of University Women (AAUW) NEW!
PHONE: (800) 326-AAUW
EMAIL: info@aauw.org
WEBSITE: http://www.aauw.org/3000/fel-grawa.html

American Association of Physics Teachers (AAPT)
Committee on Women in Physics
One Physics Ellipse
College Park, MD 20740-3845
PHONE: (301) 209-3300
WEBSITE: http://www.aapt.org

American Astronomical Society
Committee on the Status of Women
2000 Florida Avenue NW, Suite 400
Washington DC 20009-1231
PHONE: (202) 328-2010
WEBSITE: http://www.aas.org/~cswa

American Medical Women's Association (AMWA)
801 N. Fairfax Street, Suite 400
Alexandria, VA 22314
PHONE: (703) 838-0500
WEBSITE: http://www.amwa-doc.org

American Physical Society
Committee on the Status of Women in Physics (APS-CSW)
One Physics Ellipse
College Park, MD 20740-3845
PHONE: (301) 209-3200
WEBSITE: http://www.aps.org/educ/cswp/index.html

Association for Computing Machinery's Committee on Women and Computing (ACM-W)
WEBSITE: http://www.acm.org/women

Association for Women Geoscientists
P.O. Box 280
Broomfield, CO 80038-0280
WEBSITE: http://www.awg.org

Association for Women in Computing (AWC)
41 Sutter Street, Suite 1006
San Francisco, CA 94104
PHONE: (415) 905-4663
WEBSITE: http://www.awc-hq.org

Association for Women in Mathematics (AWM) NEW!
University of Maryland
4114 Computer and
Space Sciences Building
College Park, MD 0742-2461
PHONE: (301) 405-7892
WEBSITE: http://www.awm-math.org

Association for Women in Science (AWIS)
1200 New York Avenue, Suite 650
Washington DC 20005
PHONE: (202) 326-8940
WEBSITE: http://www.awis.org

Computing Research Association
Committee on the Status of Women in Computing Research
1100 Seventeenth Street NW, Suite 507
Washington DC 20036-4632
PHONE: (202) 234-2111
WEBSITE: http://www.cra.org/Activities/craw

Institute for Electrical and Electronics Engineers
Committee on Women in Engineering (IEEE WIE)
445 Hoes Lane, P.O. Box 133
Piscataway, NJ 08855-1331
WEBSITE: http://www.ieee.org/organizations/committee/women

Institute for Women and Technology (IWT)
3333 Coyote Hill Road
Palo Alto, CA 94304
PHONE: (650) 812-4496
WEBSITE: http://www.iwt.org

The Mathematical Association of America (MAA)
P.O. Box 91112
Washington DC 20090-1112
PHONE: (800) 331-1622;
WEBSITE: http://www.maa.org

National Academy of Engineering (NAE)
National Academy of Sciences
2101 Constitution Avenue NW
Washington DC 20418
PHONE: (202) 334-3677
WEBSITE: http://www.nae.edu

National Association of Biology Teachers
12030 Sunrise Valley Drive, Suite 110
Reston, VA 20191
PHONE: (703) 264-9696 *or*
(800) 406-0775
WEBSITE: http://www.nabt.org

National Council of Teachers of Mathematics
Headquarters Office
1906 Association Drive
Reston, VA 20191-9988
PHONE: (703) 620-9840
WEBSITE: http://www.nctm.org

National Organization of Gay and Lesbian Scientists and Technical Professionals
P.O. Box 91803
Pasadena, CA 91109
PHONE/FAX: (626) 791-7689 *or*
(626) 791-4393
WEBSITE: http://www.noglstp.org

National Research Council Committee on Women in Science and Engineering
2101 Constitution Avenue NW
Washington DC 20418
WEBSITE: http://www4.nas.edu/osep/cwse.nsf

National Science Foundation
4201 Wilson Boulevard
Arlington, VA 22230
PHONE: (703) 292-5111 or
(800)877-8339
WEBSITE: http://www.nsf.gov

National Science Teachers Association
1840 Wilson Boulevard
Arlington VA 22201-3000
PHONE: (703) 243-7100
WEBSITE: http://www.nsta.org

National Technical Association
PMB 221, Suite 120
5810 Kingstowne Center
Alexander, VA 22315-5711
PHONE: (757) 827-9280
WEBSITE: http://www.ntaonline.org

New Mexico Network for Women in Science and Engineering
P.O. Box 18073
Albuquerque, NM 87185
PHONE: (505) 667-8474
WEBSITE: http://www.nmnwse.org

New York Academy of Sciences
2 East 63rd Street
New York, NY 10021
PHONE: (212) 838-0230
WEBSITE: http://www.nyas.org

Sigma Xi, Scientific Research Society
99 Alexander Drive, P.O. Box 13975
Research Triangle Park, NC 27709
PHONE: (800) 243-6534
WEBSITE: http://www.sigmaxi.org

Society for Women's Health Research (SWHR) NEW
1828 L Street NW, Suite 625
Washington DC 20036
PHONE: (202) 223-8224
WEBSITE: http://www.womens-health.org

Society for Women Engineers (SWE)
120 Wall Street, Eleventh Floor
New York, NY 10005-3902
PHONE: (212) 509-9577
WEBSITE: http://www.swe.org

Women & Mathematics Network (W&M)
WEBSITE: http://www.mystery.com/WAM

Women in Engineering Programs and Advocates Network (WEPAN)
1284 CIVL Bldg. Room G167
West Lafayette, IN 47907-1284
PHONE: (765) 494-5387
FAX: (765) 494-9152
EMAIL: wiep@ecn.purdue.edu
WEBSITE: http://www.wepan.org

Women in Neuroscience (WIN)
Johns Hopkins University School of Medicine, BBRC
5510 Nathan Shock Drive, Suite 3000
Baltimore, MD 21224
PHONE: (410) 550-2800
WEBSITE: http://www.beemnet.com/win/index.htm

International Resources

African IFU Women's Network
c/o IFU—(Internationale Frauenuniversität /International Women's University)
Warmbüchenstrasse 15D-30159
Hanover, Germany
PHONE: (49) 511-126-1213
WEBSITE: http://www.vifu.de/user/ANOWA1/aiwn/aiwn.html

Asian Institute of Technology (AIT)
P.O. Box 4, Klong Luang
Pathumthani 12120, Thailand
PHONE: (662) 516-0110
WEBSITE: http://www.ait.ac.th

Asia Pacific Gender Equality Network (APGEN)
c/o UNDP Philippines
P.O. Box 7285 Domestic Airport 1300
Domestic Road, Pasay City, Philippines
or
7th Floor, NEDA sa Makati Building
106 Amorsolo Street
Legaspi Village, 1229
Makati City, Metro Manila, Philippines
PHONE: (63-2) 892-8638
FAX: (63-2) 816-4061 or 893-9598
WEBSITE: http://apgen.apdip.net/

Association Femmes et Mathematiques
11, rue Pierre et Marie Curie
75 231 Paris Cedex 05, France
PHONE: (33) 04-92-07-65-13
WEBSITE: http://math.unice.fr/~iremnice/nice/femmetmath/femmath.html

Australian Computer Society (ACS)
WEBSITE: http://www.acs.org.au/boards/cab/wittr.html

Canadian Association for Girls in Science
CAGIS National
6519-B Mississauga Road
Mississauga, Ontario, Canada, L5N 1A6
PHONE: (905) 567-7190
WEBSITE: http://publish.uwo.ca/~cagis

Canadian Mathematical Society's Committee on Women in Mathematics
Camel Office, Center for Experimental & Constructive Mathematics, Department of Mathematics and Statistics
Simon Fraser University
8888 University Drive, Burnaby
British Columbia, Canada, V5A 1S6
PHONE: (604) 291-4981
WEBSITE: http://camel.math.ca/Women

Earthwatch Australia
The Center for Field Research
126 Bank Street
Melbourne, Victoria 3205, Australia
PHONE: (03) 9682-6828
FAX: (03) 9686-3652

Earthwatch Europe
The Center for Field Research
Belsyre Court
57 Woodstock Road
Oxford OX2 6HU, United Kingdom
PHONE: (1865) 311-600
FAX: (1865) 311-383
EMAIL: cfr@uk.earthwatch.org

European Women in Mathematics
Contact: Rita Ulmanen
Department of Mathematics
P.O. Box 4 (Yliopistonkatu 5) FIN - 00014
University of Helsinki, Finland
PHONE: 358-9-191-22853
FAX: 358-9-191-23213
EMAIL: ewm@www.math.helsinki.fi
WEBSITE: http://www.math.helsinki.fi/EWM

Ewha Woman's University
11-1 Daehyun-dong
Seodaemun-gu, Seoul, 120-750, Korea
PHONE: 82-2-3277-2114
FAX: 82-2-393-5903
WEBSITE: http://www.ewha.ac.kr/ewhaeng/index.html

Female Education in Math and Science in Africa (FEMSA)
P.O. Box 53168
Nairobi, Kenya
PHONE: (254 –2) 330352
FAX: (254-2) 210709
EMAIL: femsa@fawe.org
WEBSITE: http://www.fawe.org/femsa/Defaultold.htm

Gender and Science and Technology (GASAT)
WEBSITE: http://www.gac.edu~simpson/gasat/homepage.htm

Gender, Science and Technology: International Policy Issues
Administered by Women in Global Science and Technology Network (see below).
WEBSITE: http://www.ifias.ca/gsd/gsdinfo.html

Global Alliance for Diversifying the Science and Engineering Workforce
American Association for the Advancement of Science, Directorate for Education & Human Resources Programs,
1200 New York Avenue NW
Washington DC 20005
PHONE: (202) 326-6670
Fax (202) 371-9849
EMAIL: globalalliance@engr.washington.edu
WEBSITE: http://www.globalalliancesmet.org/home.htm

International Council For Science
51 Boulevard de Montmorency
75016 Paris, France
PHONE:(33-1) 45-25-03-29
FAX: (33-1) 42-88-94-31
EMAIL: secretariat@icsu.org
WEBSITE: http://www.icsu.org

International Gender, Science and Technology Information Map
WEBSITE: http://www.wigsat.org/gstpmap.html

International Technology Education Association (ITEA)
1914 Association Drive, Suite 201
Reston, VA 20191-1539
PHONE: (703) 860-2100
FAX: (703) 860-0353
EMAIL: itea@iris.org
WEBSITE: http://www.iteawww.org

Research Foundation for Science, Technology and Ecology
A 60, Hauz Khas
New Delhi – 110016, India
PHONE: 91-11-6868077 and 6853772
FAX: 91-11-6856795
EMAIL: vshiva@giasdl01.vsnl.net.in

Society for Canadian Women in Science and Technology
417-535 Hornby Street
Vancouver, BC V6C 2E8
PHONE: 895-5814
FAX: 684-9171
EMAIL: scwist@sfu.ca
WEBSITE: http://www.harboursfu.ca/scwist/index.html

Society for Social Studies of Science
c/o Sociology Department
Louisiana State University
Baton Rouge, LA 70803
PHONE: (225) 388-5311
FAX: (225) 388-5102
EMAIL: shrum@lsu.edu
WEBSITE: http://its2.ocs.lsu.edu/guests/sss/public_html

The Association of South African Women in Science and Technology (SA WISE)
P.O. Box 34085 7707
Rhodes Gift, South Africa
FAX: (021) 689-7573
WEBSITE: http://www.sawise.org.za

Supporting Women in Information Technology (SWIFT), Canada
EMAIL: swift@interchg.ubc.ca
WEBSITE: http:// taz.cs.ubc.ca/swift

Third World Academy of Sciences (TWAS)
c/o The Abdus Salam International Center for Theoretical Physics (ICTP)
Strada Costiera 11
I-34014 Trieste, Italy
PHONE: (39) 040-2240327
FAX: (39) 040-224559
EMAIL: info@twas-online.org
WEBSITES: http://www.twas-online.org
http://www.ictp.trieste.it/~twas

Third World Network
228 Macalister Road
10400 Penang, Malaysia
phone: (60-4) 2266728 or
(60-4) 2266159
FAX: (60-4) 2264505
EMAIL: twn@igc.apc.org or
twnet@po.jaring.my
WEBSITE: http://www.twnside.org.sg

Third World Network of Scientific Organizations (TWNSO)
c/o The Abdus Salam International Center for Theoretical Physics (ICTP)
Strada Costiera 11
I-34014 Trieste, Italy
PHONE: (39) 040-2240386
FAX: (39) 040-224559
EMAIL: info@twnso.org
WEBSITE: http://www.ictp.trieste.it/~twas/TWNSO.html

Third World Organization for Women in Science (TWOWS), Italy
c/o The Abdus Salam International Center for Theoretical Physics (ICTP)
Enrico Fermi Building, Room 109
Via Beirut 6
34014 Trieste, Italy
PHONE: (39) 040-2240321
FAX: (39) 040-224559
EMAIL: info@twows.org
WEBSITES: http://www.ictp.trieste.it/~twas/TWOWS.html and http://www.twows.org

UNESCO World Conference on Science
WEBSITE: http://www.unesco.org/science/wcs

United Nations University, Institute for New Technologies (UNU/INTECH)
Keizer Karelplein 19
6211 TC Maastricht, The Netherlands
PHONE: (31) (43) 350 6300
FAX: (31) (43) 350 6399
WEBSITE: http://www.intech.unu.edu/

Women and New Technologies (UNIFEM project)
UNIFEM, 304 East 45th Street, 15th Floor,
New York, NY 10017
PHONE: (212) 906-6400
FAX: (212) 906-6705
EMAIL: unifem@undp.org
WEBSITES: http://www.unifem.undp.org
http://www.unifem.undp.org/ec_tech.htm

Women Are I.T., Australia
WEBSITE: http://www.witwomen.org.au

Women in Engineering Committee
Ryerson Polytechnic University
350 Victoria Street
Toronto, Ontario, M5B 2K3, Canada
PHONE: (416) 979-5000 ext. 7220
EMAIL: womeng@ee.ryerson.ca
WEBSITE: http://www.ee.ryerson.ca:8080/~womeng

Women in Global Science and Technology Network
623 Brimley Road, Grafton
Ontario, K0K 2G0 Canada
PHONE: (905) 349-9962
FAX: (905) 349-2066
WEBSITE: http://www.wigsat.org

Women in Information Technology (WIT)
Suite 5, 39 Tinarra Crescent
Kenmore Hills QLD 4069, Australia
EMAIL: info@wit.org.au
WEBSITE: http://www.wit.org.au

Women in Neuroscience (WIN)
Johns Hopkins University, BBRC 5510
Nathan Shock Drive, Suite 3000
Baltimore, MD 21224
CONTACT: Elise Weerts, Ph.D.
WEBSITE: http://www.beemnet.com/win/index.htm

Women in Nuclear Global (WIN Global)
P.O. Box 11988
London SW1 X7ZE, United Kingdom
PHONE/FAX: (44) 20-7-581-1697
EMAIL: win@winglobal.demon.co.uk
WEBSITE: http://www.etceteraweb.com/WIN/WININ3.html

Women in Technology International (WITI)
6345 Balboa Boulevard #257
Encino, CA 91316
PHONE: (WITHIN US)
(800) 334-WITI (9484)
PHONE: (818) 342-9746
FAX: (818) 342-9891
WEBSITE: http://www.witi.com/index-c.shtml

Women on the Net (UNESCO/Society for International Development project)
WEBSITE: http://www.waw.be/sid/won/won.htm

Online Resources for Professional Development

Advancing Women
(Corporate Office) P.O. Box 6642
San Antonio, TX 78209
PHONE: (210) 822-1103
FAX: (210) 821-5119
WEBSITE: http://www.advancingwomen.com

Changing Channels
202 London Hall
Columbia, MO 65211-2230
PHONE: (573) 882-3099
EMAIL: enter@missouri.edu
WEBSITE: http://www.channels.org

Computer Professionals for Social Responsibility (CPSR): Women and Computing
P.O. Box 717
Palo Alto, CA 94302
WEBSITE: http://www.cpsr.org/program/gender/index.html

Dataline
848 California Street
San Francisco, CA 94108
PHONE: (415) 882-7320
FAX: (415) 397-8984
WEBSITE: http://cyberwerks.com/dataline

Engineeringwomen.com
EMAIL: info@engineeringwomen.com
WEBSITE: http://www.engineeringwomen.com

Eisenhower National Clearinghouse
1929 Kenny Road
Columbus, OH 43210
PHONE: (800) 621-5785 or
(614) 292-7784
FAX: (614) 292-2066
EMAIL: info@enc.org
WEBSITE: http://www.enc.org

Webgrrls.com
WEBSITE: http://www.webgrrls.com

WEEA Equity Resource Center
EDC
55 Chapel Street
Newton, MA 02458-1060
PHONE: (800) 225-3088 or
(617) 969-7100
FAX: (617)332-4318
EMAIL: WEEActr@edc.org
WEBSITE: http://www.edc.org/WomensEquity/about.htm

Women and Mathematics Information Server
c/o The Mathematical Association of America
1529 Eighteenth Street N
Washington DC 20036-1385
PHONE: (800) 741-9415 or
(202) 387-5200
FAX: (202) 265-2384
WEBSITE: http://www.mystery.com/WAM

Women in Biology Internet Launch pages
WEBSITE: http://pingu.salk.edu/~forsburg/bio.html

Women in Computer Science
WEBSITE: http://www.mills.edu/ACAD_INFO/MCS/SPERTUS/Gender/gender.html

Women's Technology Cluster
1207 Indiana Street, Suite 4
San Francisco, CA 94107
PHONE: (415) 970-5090
FAX: (415) 970-5095
WEBSITE: www.womenstechcluster.org

FUNDING SOURCES

General Funding Sources

These organizations offer funding for education and professional development.

Alfred P. Sloan Foundation
PHONE: (212) 649-1649
WEBSITE: http://www.sloan.org/main.htm

American Association of University Women (AAUW) Educational Foundation
PHONE: (800) 326-AAUW
EMAIL: info@aauw.org
WEBSITE: http://www.aauw.org/3000/felgrawa.html

Association for Women Geoscientists
EMAIL: office@awg.org or president@awg.org
WEBSITE: http://www.awg.org

Association for Women in Science (AWIS)
PHONE: (202) 326-8940
EMAIL: awis@awis.org
WEBSITE: http://www.awis.org

AT&T Foundation, NY
PHONE: (212) 387-5352
WEBSITE: http://www.att.com/foundation

Bill & Melinda Gates Foundation
PHONE: (206) 709-3100
EMAIL: infor@gatesfoundation.org
WEBSITE: http://www.gatesfoundation.org

Foundation for Technology Education (FTE)
PHONE: (703) 860-2100
EMAIL: iteaordr@iris.org
WEBSITE: http://www.iteawww.org/11.html

General Electric Fund
EMAIL: gefeedback@appl.ge.com
WEBSITE: http://www.ge.com/community

Henry Luce Foundation
PHONE: (212) 489-7700
WEBSITE: http://www.hluce.org/index.html

Hewlett-Packard
WEBSITE: http://welcome.hp.com/country/us/eng/welcome.htm

Intel
WEBSITE: http://www.intel.com

Lucent Technologies
EMAIL: Fellowships@lucent.com or Foundation@lucent.com
WEBSITE: http://www.bell-labs.com/fellowships/GRPW

The Mathematical Association of America (MAA)
PHONE: (800) 741-9415 or
(202) 387-5200
WEBSITE: http://www.maa.org

National Physical Science Consortium
PHONE: (800) 952-4118 *or* (505) 646-6038
EMAIL: npsc@npsc.org
WEBSITE: http://www.npsc.org

National Science Foundation
PHONE: (800) 877-8339 *or* (703) 292-5111
TDD: (703) 306-0090
WEBSITE: http://www.nsf.gov

New York Academy of Sciences
PHONE: (212) 838-0230
WEBSITE: http://www.nyas.org

Sigma Xi, Scientific Research Society
PHONE: (800) 243-6534
WEBSITE: http://www.sigmaxi.org

Society of Women Engineers (SWE)
PHONE: (212) 509-9577
WEBSITE: http://www.swe.org

Funding for K–12 Education Programs

Eleanor Roosevelt Teacher Fellowships and Community Action Grants NEW!
American Association of University Women
PHONE: (800) 326-AAUW
EMAIL: info@aauw.org
WEBSITE: http://www.aauw.org/3000/felgrawa.html

Flatiron Future Fund
Flatiron Partners
257 Park Avenue South, 15th Floor
New York, NY 10010
PHONE: (212) 915-9055
WEBSITE: http://www.flatironpartners.com/futurefund.html

Intel Science Talent Search
WEBSITE: http://www.intel.com/education/sts

Intel International Science and Engineering Fair (ISEF)
WEBSITE: http://www.intel.com/education/isef/index.htm

Mathematical Association of America (MAA), The Tensor Foundation
PHONE: (800) 741-9415 *or* (202) 387-5200
WEBSITES: http://www.maa.org and http://www.maa.org/data/projects/maaprograms.html

SBC Foundation
PHONE: (800) 591-9663
WEBSITE: http://www.sbc.com/Community

Three Guineas Fund
1207 Indiana Street, Suite 1
San Francisco, CA 94107
PHONE: (415) 550-4783
EMAIL: info@3gf.org
WEBSITE: www.3gf.org

Funding for Undergraduate Programs

Association for Women Geoscientists
EMAIL: office@awg.org *or* president@awg.org
WEBSITE: http://www.awg.org

Association for Women in Science, Education Foundation: Undergraduate Awards
PHONE: (202) 326-8940
EMAIL: awis@awis.org
WEBSITE: http://www.awis.org

The Clare Boothe Luce Program, Henry Luce Foundation
PHONE: (212) 489-7700
WEBSITE: http://www.hluce.org/index.html

Mathematical Association of America (MAA), The Tensor Foundation, DC
PHONE: (800) 741-9415 *or* (202) 387-5200
WEBSITES: http://www.maa.org *or* http://www.maa.org/data/projects/maaprograms.html

Society of Women Engineers (SWE)
PHONE: (212) 509-9577
WEBSITE: http://www.swe.org

Funding for Graduate Education

American Association of University Women, Education Foundation NEW!
PHONE: (800) 326-AAUW
EMAIL: info@aauw.org
WEBSITE: http://www.aauw.org/3000/felgrawa.html

Amelia Earhart Fellowship Award
Zonta International Foundation
PHONE: (312) 930-5848
EMAIL: zontafdtn@zonta.org
WEBSITE: http://www.zonta.org/Programs/programs.html

Association for Women Geoscientists
EMAIL: office@awg.org *or* president@awg.org
WEBSITE: http://www.awg.org

Association for Women in Science Education Foundation: Graduate Awards
PHONE: (202) 326-8940
EMAIL: awis@awis.org
WEBSITE: http://www.awis.org

Chrysalis Scholarship Fund
G&H Production Company, LLC
518 17th Street, #930
Denver, CO 80202
PHONE: (330) 534-0708
EMAIL: gandh@idt.net
WEBSITE: http://www.awg.org/AWGFoundation/chrysalis.html

Clare Boothe Luce Program, Henry Luce Foundation
PHONE: (212) 489-7700
WEBSITE: http://www.hluce.org/index.html

Graduate Fellowships in the Physical Sciences, National Physical Science Consortium
PHONE: (800) 952-4118 *or* (505) 646-6038
EMAIL: npsc@npsc.org
WEBSITE: http://www.npsc.org

Graduate Research Program for Women (GRPW), Lucent Technologies Foundation
EMAIL: Fellowships@lucent.com *or* Foundation@lucent.com
WEBSITE: http://www.bell-labs.com/fellowships/GRPW

Society of Women Engineers (SWE)
PHONE: (212) 509-9577
WEBSITE: http://www.swe.org

Funding for Professional Development

American Association of University Women, Education Foundation
PHONE: (800) 326-AAUW
EMAIL: info@aauw.org
WEBSITE: http://www.aauw.org/3000/felgrawa.html

Ameritech
444 Michigan Avenue, Floor 2
Detroit, MI 48226
PHONE: (877) 444-6944
FAX: (888) 308-7186
EMAIL: snowerock@mail.ameritech.com
WEBSITE: http://www.ameritech.com

AT&T Foundation, NY
PHONE: (212) 387-5352
WEBSITE: http://www.att.com/foundation

Clare Boothe Luce Program, Henry Luce Foundation
PHONE: (212) 489-7700
WEBSITE: http://www.hluce.org/index.html

Foundation for Technology Education (FTE)
PHONE: (703) 860-2100
EMAIL: iteaordr@iris.org
WEBSITE: http://www.iteawww.org/11.html

Intel
WEBSITE: http://www.intel.com

National Science Foundation
- ADVANCE Institutional Transformation Awards
- ADVANCE Fellows Awards
- ADVANCE Leadership Awards

EMAIL: advance@nsf.gov
WEBSITE: http://www.nsf.gov

SBC Foundation
PHONE: (800) 591-9663
WEBSITE: http://www.sbc.com/Community

Student Challenge Awards Program
Earthwatch Institute
Center for Field Research
3 Clocktower Place, Suite 100, Box 75
Maynard, MA 01754
PHONE: (978) 461-0081
FAX: (978) 461 2332
WEBSITE: http://www.earthwatch.org/cfr/CFRdurfee.html

Three Guineas Fund
1207 Indiana Street, Suite 1
San Francisco, CA 94107
EMAIL: info@3gf.org
WEBSITE: www.3gf.org

Universal Service Administrative Company, Schools and Libraries Division
PHONE: (888) 203-8100
EMAIL: question@slcfund.org
WEBSITE: www.sl.universalservice.org

OTHER ONLINE RESOURCES AND REPORTS

AI-Systers
EMAIL: ai-systers-request@crl.dec.com

The Archives of Women in Science and Engineering, Iowa State University
WEBSITE: http://www.lib.iastate.edu/spcl/wise/wise.html

Biographies of Women Mathematicians
WEBSITE: http://www.agnesscott.edu/lriddle/women/women.htm

Contributions of 20th-Century Women to Physics
WEBSITE: http://www.physics.ucla.edu/~cwp

Faces of Science: African Americans in the Sciences
WEBSITE: http://www.princeton.edu/~mcbrown/display/faces.html

Femina.com
WEBSITE: http://femina.cybergrrl.com/explorer.htm

4000 Years of Women in Science
WEBSITE: http://crux.astr.ua.edu/4000ws/4000ws.html

Girls Count
WEBSITE: http://www.girlscount.org/articles/default.html

Land of Plenty: Diversity as America's Competitive Edge in Science, Engineering and Technology, *Report of the Congressional Commission on the Advancement of Women and Minorities in Science, Engineering and Technology Development (CAWMSET), 2000.*
WEBSITE: http://www.nsf.gov/od/cawmset/report.htm

Math Forum: Key Issues—Women and Mathematics
WEBSITE: http://www.forum.swarthmore.edu

Mathematicians of the African Diaspora
WEBSITE: http://www.math.buffalo.edu/mad/mad0.html

NET EQUITY: Equity Internet Resources
WEBSITE: http://www.col-ed.org/smcnws/equity

The Online Ethics Center for Engineering and Science
EMAIL: feedback@onlineethics.org
WEBSITE: http://onlineethics.org/ecsel/ index.html

Pioneer Women: Pushing the Frontiers of Science and Engineering at Oak Ridge National Laboratory
WEBSITE: http://www.ornl.gov/publications/women/women.html

SESTAT Integrated Databases
WEBSITE: http://srsstats.sbe.nsf.gov

SciEd: Science and Mathematics Education Resources
WEBSITE: http://www-hpcc.astro.washington.edu/scied/science.html

Society for Advancement of Chicanos and Native Americans in Science
WEBSITE: http://www.sacnas.org

Systers
WEBSITE: http://www.systers.org

Third International Mathematics and Science Study-Repeat (TIMSS-R)
WEBSITE: http://nces.ed.gov/TIMSS/timss-r/index.asp

Women and Genetics in Contemporary Society
WEBSITE: http://www-unix.oit.umass.edu/~fholmes

Women and Gender Studies Science and Technology Web Sites
WEBSITE: http://libraries.mit.edu/humanities/WomensStudies/Tech2.html

Women and Minorities in Science and Engineering
WEBSITE: http://www.mills.edu/ACAD_INFO/MCS/SPERTUS/Gender/wom_and_min.html

Women, Minorities and People with Disabilities in Science and Engineering
WEBSITE: http://www.nsf.gov/sbe/srs/women/start.htm

Women in Mathematics: Resources
WEBSITE: http://camel.math.ca/Women/index.html

Women in Science and Engineering Bulletin Board
EMAIL: WISEnet@uic.edu

Women-Related Science/Technology Email Lists
WEBSITE: http://www-unix.umbc.edu/~korenman/wmst/f_sci.html

B. SCIENCE AND TECHNOLOGY PROGRAMS OF NCRW MEMBER CENTERS

Listed in this section is a guide to programs in science, engineering and technology at NCRW Member Centers and their host institutions. The centers are organized alphabetically, by state. Contact information is for NCRW member centers, not necessarily for their host institutions. The guide includes several conferences, projects and research initiatives that may not be continuing programs. They have been included since the conference papers, reports and documents that often result from such projects may help those seeking to initiate similar projects.

ARIZONA

The University of Arizona

Southwest Institute for Research on Women (SIROW)
Communication 108
Box 210025
Tucson, AZ 85721
EXECUTIVE DIRECTOR: Janice Monk
PHONE: (520) 621-7338
FAX: (520) 621-1533
WEBSITE: http://w3.arizona.edu/~ws

RESEARCH

Breaking the Silences: A Faculty-Student Action Project for Graduate Women in Science and Mathematics
WEBSITE: http://w3.arizona.edu/~ws/science/nsf

Funded by the National Science Foundation, this project was designed to analyze the strengths and limitations of graduate education for women in four University of Arizona graduate departments: mathematics, ecology and evolutionary biology, molecular and cellular biology and chemistry. This research and action project involved: 1) an institutional analysis of the social shaping of science; 2) a dialogue among faculty and graduate students about their differing perceptions of the graduate experience; and 3) faculty and students designing and implementing changes to improve the climate for women in graduate education. This project suggests that institutionalizing the project's facilitated dialogue model between faculty and students will strengthen graduate education for all students.

Women and Scientific Literacy: Building Two-Way Streets

This project at the University of Arizona aims to transform Women's Studies and the Sciences through curriculum and faculty development efforts. This three-year project, sponsored by the American Association of Colleges and Universities and the National Science Foundation will expand, connect and integrate curricula in Women's Studies and the Sciences (natural and physical sciences, mathematics and engineering).

UNIVERSITY PROGRAMS

Women in Science and Engineering (WISE)

Established in 1976, the Women in Science and Engineering (WISE) Program of the Southwest Institute for Research on Women maintains a multi-faceted outreach program to undergraduate and graduate students at the University, to public school teachers across the state (especially in southern Arizona), and to K–12 students in southern Arizona. Several programs focus on motivating and supporting girls and young women to enter science-related careers.

High School Mentoring Program

The High School Mentoring Program, created in 1990, is offered twice a year in the fall and spring semesters. The program matches girls considering careers in the sciences and engineering with successful women professionals in non-traditional fields, enabling girls to 'job shadow' women for one day, seeing firsthand what their jobs entail.

Expanding Your Horizons Conference (EYH)

The annual EYH Conference serves 200–325 girls, almost half of them minority students, from middle schools and high schools throughout Southern Arizona. Participants explore non-traditional careers in the fields of math, science, engineering, technology and other non-traditional fields for women.

Harriet Silverman Scholarship

WISE awards scholarships annually to young women who are high school seniors and successful in math, science or engineering. WISE also offers awards at the annual Southern Arizona Regional Science and Engineering Fair (WEBSITE: http://www.sarsef.com) to female students at the junior high and high school levels. In addition, WISE gives financial support by providing scholarships for girls to attend other university programs such as the Chemistry Summer Camp and the Summer Math Institute.

The Helen S. Schaefer Scholarship

The Helen S. Schaefer Scholarship for Women in Chemistry is given to an upper level undergraduate student who has career goals in mathematics or the sciences. This award of $500 is designed to help female students who are in good standing entering their sophomore, junior or senior years of study with their tuition.

CALIFORNIA

University of California, Davis

Consortium for Women and Research
One Shields Avenue
Davis, CA 95616
DIRECTOR: Kari Lokke, Ph.D.
PHONE: (530) 754-8851
FAX: (530) 754-8853
WEBSITE: http://ovcr.ucdavis.edu/oru/cwr/index.htm

UNIVERSITY PROGRAMS

Opportunities in Engineering and Science (OES)
PHONE: (530) 752-1647
FAX: (530) 752-1820
WEBSITE: http://www.aes.ucdavis.edu/outreach/oes/index.htm

OES was designed to: 1) educate students and faculty on the challenges and opportunities encountered by women in science and engineering; 2) stimulate positive academic development in these fields by demonstrating their

social relevance; and 3) develop the educational framework necessary to encourage women to continue in engineering or mathematical and physical sciences graduate schools. OES will cease to exist from September 2001, but offered the following programs:

OES Mentoring Program

Undergraduate women majoring in mathematics, statistics or physical sciences learn about graduate school and the life of a graduate student through the OES Mentoring Program that pairs undergraduate women with graduate students majoring in the same field of study. This program is an extension of the Women's Engineering Link (WEL), sponsored by the Center for Women in Engineering.

OES Travel Awards

Graduate students may apply for an OES Travel Grant to take advantage of professional conferences and the networking opportunities they present. The grants are awarded through collaboration with the Pro Femina Research Consortium.

Community College Partnership

In order to help students transition successfully into the four year science and engineering programs, UC Davis and neighboring community colleges have formed partnerships and are working on a series of programs to make the transfer process less stressful.

First-Year Student Retreat

During their first year on campus, transfer students and first-year students may participate in a retreat designed to strengthen the community of engineering and science students. The retreat will include an educational forum on the challenges and viewpoints of women in math, science and engineering.

Science: Majors, Minors and Matters Course

Currently in the developmental stage, this is an introductory course for students interested in math and physical sciences as a major that demonstrates the relevance of each of the majors in the Division of Mathematics and Physical Science.

Introduction to Engineering Principles Courses

First year engineering students seeking a "hands-on" interactive learning experience may enroll in these courses developed within each engineering department.

Distinguished Lectures Series

Women researchers are invited to UC Davis to present a research lecture and to host an informal autobiographical discussion about their career experiences, providing an opportunity for faculty and students to meet distinguished women scientists and engineers from around the country.

The Center for Women in Engineering (WIE)
PHONE: (530) 752-INFO (4636)
FAX: (530) 752-8058
DIRECTOR: Karin Mack
WEBSITE: http://wie.ucdavis.edu

WIE was established in 1990 to address issues facing women studying to become engineers. WIE has focused attention on changing the academic environment for women in engineering by researching barriers to their success and developing programs that reduce or eliminate these barriers. WIE has programs in career development, outreach, mentoring and community building.

University of California, Los Angeles

Center for the Study of Women
288 Kinsey Hall
Los Angeles, CA 90095-1504
DIRECTOR: Miriam Silverberg
PHONE: (310) 825-0590
FAX: (310) 206-7700
WEBSITE: http://women.ucla.edu/csw

CONFERENCES

"The Double Bind Revisited": Women of Color in Math, Science and Engineering in the United States
SPONSORED BY: CSW, May 1999

This conference explored the progress and opportunities available for women of color in the math, science and engineering fields 20 years after the original American Association for the Advancement of Science report.

Educating Girls: New Issues in Science and Technology Education
SPONSORED BY: CSW, November 2000

This conference explored what kind of girls do science and why, with a special focus on issues of race and class.

University of California, Los Angeles

Higher Education Research Institute (HERI)
Graduate School of Education and Information Studies
3005 Moore Hall, Box 951521
Los Angeles, CA 90095-1521
DIRECTOR: Alexander W. Astin
PHONE: (310) 825-1925
FAX: (310) 206-2228
EMAIL: heri@ucla.edu
WEBSITE: http://www.gseis.ucla.edu/heri/heri.html

REPORTS

Undergraduate Science Education: The Impact of Different College Environments on the Educational Pipeline in the Sciences, 1992

Funded by the National Science Foundation, the project analyzed the impact of various college environments and student experiences on students' interest in and persistence toward majors and careers in the science. The principal investigators and co-authors were Alexander W. Astin and Helen S. Astin.

Graduate Education in Science, Math and Engineering: Gender Differences in Enrollment, Persistence and Satisfaction, 1998.
Final report to the Alfred P. Sloan Foundation.

This project examines gender differences in enrollment, persistence and satisfaction in science, math and engineering (SME) graduate education. Data on graduate students were collected through a survey of 1,273 students (832 men and 441 women) who enrolled in SME graduate programs nationwide, as well as through interviews conducted with students at selected case study institutions. Linda J. Sax, principal investigator.

PUBLICATIONS

Members of HERI staff have contributed articles to journals and edited volumes. A select number of titles are:

Sax, L.J., *2001*
"Undergraduate Science Majors: Gender Differences in Who Goes to Graduate School." *The Review of Higher Education* 24(2): 153–172.

Astin, H.S. & Sax, L.J., *1996*
"Undergraduate Women in Science: Personal and Environmental Influences in the Development of Scientific Talent." *The Equity Equation: Women in Science, Mathematics and Engineering*. C. Davis, A. Ginorio, C. Hollenshead, B. Lazarus, and P. Rayman (eds) San Francisco: Jossey-Bass.

Sax, L.J., *1995*
"Predicting Gender and Major-Field Differences in Mathematical Self-Concept during College." *Journal of Women and Minorities in Science and Engineering* 1(4) 29: 1–307.

Sax, L.J., *1994*
"Mathematical Self-Concept: How College Reinforces the Gender Gap." *Research in Higher Education*, 35(2): 141–166.

Sax, L.J., *1994*
"Retaining Tomorrow's Scientists: Exploring the Factors that Keep Male and Female College Students Interested in Science Careers." *Journal of Women and Minorities in Science and Engineering*. 1: 45–62.

Mills College

Women's Leadership Institute (WLI)
5000 MacArthur Boulevard
Oakland, CA 94613
DIRECTOR: Edna Mitchell, Ph.D.
PHONE: (510) 430-2019
FAX: (510) 430-3233
WEBSITE: http://www.mills.edu/WLI/wli.home.html

PROGRAMS

Advancing Women in Medicine and Health Science Careers

A symposium for women in the health care professions focusing on the improvement of women's professional education in their fields, exploring barriers to career advancement, sharing experiences about the work environment, setting priorities for policy action and proposing strategies for women's professional progress.

Advancing Women's Leadership in Science

In 1994, WLI, with the assistance of a nine-member national advisory committee, sponsored the first national Women in Science Summit where 52 of the country's leading women scientists gathered to create the foundation for an action plan that would advance women's leadership in science. This Summit produced an Action Plan to the year 2000 published in 1995, which is available from the WLI website. In 1997 WLI hosted the California Women in Science Leadership Conference.

Stanford University

Institute for Research on Women and Gender
Serra House
556 Salvatierra Walk
Stanford, CA 94305-8640
DIRECTOR: Laura L. Carstensen, Ph.D.
PHONE: (650) 723-1994
FAX: (650) 725-0374
WEBSITE: http://www.stanford.edu/group/IRWG

UNIVERSITY PROGRAMS

Women in Computer Science (WICS)
WEBSITE: http://www-cs-students.stanford.edu/~womencs

WICS is an organization for women in Computer Science at Stanford University. The group maintains a mailing list for communication within the group and with women affiliated with the department in various ways. In addition, it provides support for some activities such as quarterly get-togethers and lunch meetings for WICS members with local and visiting women in industry and in academia.

DISTRICT OF COLUMBIA

American Association of University Women (AAUW)

Educational Foundation
1111 Sixteenth St. NW
Washington DC 20036
DIRECTOR OF RESEARCH: Pamela Haag
PHONE: (202) 728-7613 *or*
(800) 326-AAUW
FAX: (202) 872-1425
TDD: (202) 785-7777
EMAIL: info@aauw.org

PROGRAMS

Math, Science and Technology Programs For Girls

WEBSITE: http://www.aauw.org/2000/models.html

Individuals, AAUW branch and state organizations, schools, and community groups are designing and implementing creative projects to improve girls' achievement in math, science and technology, and to help make computer technology challenging and engaging for all students. AAUW provides a listing of these math, science and technology programs for girls on the Web. In 2001, the database will be updated to include all projects funded through the AAUW Educational Foundation's teacher fellowships and community action grants programs from 1998-2001.

FUNDING

Eleanor Roosevelt Teacher Fellowships

AAUW Educational Foundation, Department 60
2201 N. Dodge Street
Iowa City, IA 52243-4030
PHONE: (319) 337-1716 ext. 60.
WEBSITE: http://www.aauw.org/3000/fdnfelgra/ertf.html

The AAUW educational foundation provides teacher fellowships to women K-12 public school teachers for professional development in gender equity and math, science and/or technology, including college courses, seminars and professional workshops. The fellowship program also supports development of an innovative curriculum project to encourage girls' interest and achievement in math, science and/or technology.

Fellowships, Grants, and Awards

The AAUW Educational Foundation, which is one of the largest private sources of funding for graduate women in the world, supports aspiring scholars around the globe, teachers and activists in local communities, women at critical stages of their careers, and those pursuing professions where women are underrepresented. Information and applications for fellowships and grants are available on this site.
WEBSITE: http://www.aauw.org/3000/felgrawa.html.

The Foundation also makes several prestigious annual awards to recognize excellence in achievement.

PUBLICATIONS

Tech Savvy: Educating Girls in the Computer Age, released in 2000

This report reveals the emerging gaps in areas such as technology that threaten to disenfranchise girls as they confront 21st-century demands. For more information, visit http://www.aauw.org/2000/techsavvy.html.

Gender Gaps: Where Schools Still Fail Our Children

An AAUW Ed ucational Foundation report released in 1998 evaluates the disparity between the success of girls and boys in the school system. For more information, visit: http://www.aauw.org/2000/gg.html.

Tech Check Database of Model Schools

EMAIL: helpline@aauw.org
WEBSITE: http://www.aauw.org/2000/ techchk.html

The AAUW developed Tech Check, a guide to help schools assess the technology opportunities they offer female students, in conjunction with the release of *Gender Gaps: Where Schools Still Fail Our Children*. The AAUW provides free copies of *Tech Check* upon request. This is a questionnaire to be filled out by schools.

Association of American Colleges and Universities (AAC&U)

Program on the Status and Education of Women
1818 R Street NW
Washington DC 20009
DIRECTOR: Caryn McTighe Musil
PHONE: (202) 387-3760
FAX: (202) 265-9532
WEBSITE: http://AACU-EDU.org/initiatives/psew.html

PROGRAMS

Women and Scientific Literacy: Building Two-Way Streets

WEBSITE: http://www.aacu-edu.org/Initiatives/scilit.html

This program seeks to make science more attractive to women by expanding the content and teaching methods of the science curriculum in higher education, within traditional science departments as well as humanities and social science courses. Made possible by an award from the National Science Foundation and with leadership from AAC&U's Program on the Status and Education of Women, this initiative brings together ten competitively chosen colleges and universities in a three-year curriculum and faculty development project. The project has also published special issues of On Campus with Women and a monograph available free of charge called Frequently Asked Questions About Feminist Science Studies. The final project publication, Science, Gender, and the Undergraduate Curriculum, will be available in summer 2001.

PUBLICATIONS

On Campus with Women (OCWW)

PHONE: (202) 884-7434
CONTACT: Nadia Steinzor
EMAIL: steinzor@aacu.nw.dc.us
WEBSITE: http://www.aacu-edu.org/Publications/ocww.html

Connecting Women and Technology
Vol. 29, No. 4, Summer 2000

This issue includes articles on the role of women in technology and the challenges to drawing more women into the field to shape its designs and share its jobs. Articles include: "Improving the Information Technology Climate for Women," "Technology, Gender and the Future of Library Science," "The Role of Gender in Email Advice to Undergraduates," and an interview with Anita Borg.

Women in Scientific Literacy
Vol. 29, No. 1, Fall 1999

This issue includes articles on the ways in which feminist science studies can create new intellectual pathways among the sciences, social sciences and humanities that deepen the knowledge about feminist science. Articles include: "Bridging the Language Gap Across Disciplines," "The Transformative Power of Feminist Science," and "Science and Engineering: Are Women of Color Falling Through the Cracks?"

Warming the Climate for Women in Academic Science
Publications Desk
AAC&U
1818 R Street NW
Washington DC 20009
PHONE: (800) 297-3775
EMAIL: pub_desk@aacu.nw.dc.us

This report, written by Angela B. Ginorio, provides a comprehensive review of the literature about what attracts and retains girls and women in the sciences. It offers concrete recommendations about how to improve on those successes for undergraduate students, graduate students and faculty members in science, mathematics and engineering.

Institute for Women's Policy Research (IWPR)

1707 L Street NW, Suite 750
Washington DC 20036
EXECUTIVE DIRECTOR:
Heidi Hartmann, Ph.D.
PHONE: (202) 785-5100
FAX: (202) 833-4362
WEBSITE: http://www.iwpr.org

PUBLICATIONS AND RESEARCH

IWPR is currently researching job training for low-income people, as well as opportunities for nontraditional training for women leaving welfare. An article based on results from preliminary data, entitled "Job Training Under Welfare Reform: Opportunities for and Obstacles to Economic Self-Sufficiency Among Low-Income Women" appeared in the *Georgetown Journal on Poverty Law and Policy*, Summer 2000. In addition, the IWPR publication, *Part-Time Opportunities for Professionals and Managers: Where Are They, Who Uses Them and Why*, discusses part-time employment options to ease the difficulties women face when they blend parenting with professional and managerial jobs. Most IWPR studies can be downloaded from the website.

CONFERENCES

The Sixth Women's Policy Research Conference, "Facing the Facts, Forging the Future," co-sponsored by the Women's Studies Program at George Washington University in June 2001, will include discussions on women in technology as part of a broad analysis of women's health, employment and pay equity, and globalization.

National Center for Policy Research for Women & Families (CPR)

1444 Eye Street NW, Suite 900
Washington DC 20005
PRESIDENT: Diana Zuckerman, Ph.D.
PHONE: (202) 216-9507
FAX: (202) 216-9845
WEBSITE: www.cpr4womenandfamilies.org

PROGRAMS

Breast Cancer Public Education Campaign

CPR's public education campaign targets patients, doctors and the media. The goal is to make sure that all women who are newly diagnosed with early-stage breast cancer have access to the latest research information. The information will be conveyed in brochures for patients and fact sheets for health professionals and advocates, so that patients can make the treatment choices that are best for them.

Breast Implants and Women's Health

By carefully reviewing the research that has been conducted on breast implants, interviewing women with implants, writing articles, meeting with FDA officials, meeting with breast cancer groups and talking to the media, CPR provides accurate and balanced information to consumers, health care professionals and the general public.

Early Puberty

CPR is working with other researchers, the media and policy makers to call attention to the increase in early puberty among girls in the U.S. Our analyses will provide information about the likely environmental causes and the potential consequences for girls' mental health and safety.

Policy Forums and Capitol Hill Briefings

In March 2001, CPR held the first Senate Policy Forum on Women and Families, featuring the new women senators. The policy forum was held in the U.S. Senate. Other policy forums and Congressional briefings are planned for 2001 and 2002.

CPR staff members have participated in Congressional briefings and public meetings with executive branch officials on a range of topics, including food safety, improving research on the impact of medications taken during pregnancy, and the safety of medical products.

INTERNSHIPS/FELLOWSHIPS

CPR offers internships and fellowships to undergraduate and graduate students who want to learn about women's health issues and the Washington policy scene. Fulltime fellowship positions are for those with a college degree and offer a stipend.

PUBLICATIONS

Zuckerman, D.M., *Fall 2000*
"The need to Improve Informed Consent for Breast Cancer Patients." *Journal of the American Medical Women's Association*. 55: 285–289.

Zuckerman, D.M.
"What the FDA Should Learn from the RU-486 Marathon." *The Washington Post*, Sunday, October 22, 2000.

Zuckerman, D.M.
"Calling for Informed Consent on Silicone Breast Implants or an End to Sales." *MAMM*, March 2001.

Zuckerman, D.M., *Winter 2001*
"When Little Girls Become Women: Early Onset of Puberty in Girls." *The Ribbon: A Newsletter of the Cornell Program on Breast Cancer and Environmental Risk Factors in New York*, 6: 6–8.

RESEARCH

Blind Adults and Children

CPR is completing a study of the experiences and unmet needs of blind adults and children in the U.S., with special attention to the growing number of elderly blind women who are living alone.

In general, CPR reviews, critiques, synthesizes, and explains the research conducted by others.

CONFERENCES

In September 2001, CPR will host a national conference entitled "Using Research to Inform Patients of Breast Cancer Surgery Options." The conference will bring together a group of experts representing health professionals, researchers, and patient advocates, to develop strategies to increase the likelihood that women who are newly diagnosed with early-stage breast cancer will be accurately informed about their surgical options (and related treatment such as radiation). It will focus primarily on information about different kinds of mastectomies, breast-conserving surgery and radiation.

National Women's Law Center (NWLC)

11 Dupont Circle NW, Suite 800
Washington DC 20036
CO-PRESIDENT: Marcia Greenberger
CO-PRESIDENT: Nancy Duff Campbell
PHONE: (202) 588-5180
FAX: (202) 588-5185
WEBSITE: http://www.nwlc.org

PUBLICATIONS

Putting the Law on Your Side: A Guide for Women and Girls to Equal Opportunity in Career Education and Job Training

The NWLC is working to expand educational opportunities for young women and girls by making non-traditional, high technology careers, such as those in science and technology, accessible to them. The Center has launched a public education campaign with this publication to address the persistent problem of sex discrimination in career and technical education programs. This publication is written to help female students recognize sex discrimination in career and technical education programs and to explain how they can use federal civil rights laws to protect their rights to equal opportunity. The Center also offers training in this area.

Society for Women's Health Research (SWHR)

1828 L Street NW, Suite 625
Washington DC 20036
PRESIDENT & CEO: Phyllis Greenberger, MSW
PHONE: (202) 223-8224
FAX: (202) 833-3472
EMAIL: information@womens-health.org
WEBSITE: http://www.womens-health.org

RESEARCH

The Society for Women's Health Research

Formerly the Society for the Advancement of Women's Health Research, seeks to improve the health of women through research. The Society grew out of a mounting concern that the health of all American women was at risk due to biases in biomedical research. SWHR fights for greater research funding for what are often known as "women's diseases," such as breast cancer, osteoporosis and reproductive cancers, and for diseases traditionally associated with men, such as heart disease and lung cancer. The Society's three strategic priorities are to promote the study and acceptance of gender-based biology in the scientific community, to enhance the recruitment and retention of women in clinical trials and to increase research funding for women's health research.

Women's Research and Education Institute (WREI)

1750 New York Avenue, Suite 350
Washington DC 20009
PRESIDENT: Susan Scanlan
PHONE: (202) 628-0444
FAX: (202) 628-0458
WEBSITE: http://www.wrei.org

PROGRAMS/RESOURCES

WREI offers information on science and technology for young women. WREI resident scholars and fellows have given speeches and organized conferences that show young women that they, too, can become astronauts and scientists.

FLORIDA

University of Florida

Center for Women's Studies and Gender Research
3324 Turlington Hall
P.O. Box 117352
Gainesville, FL 32611
DIRECTOR: Angel Kwolek-Folland
PHONE: (352) 392-3365
FAX: (352) 392-4873
WEBSITE: http://web.wst.ufl.edu/index.html

PROGRAMS

The Center for Women's Studies and Gender Research offers more than 20 courses annually under the women's studies designator by core and affiliated faculty in the Medical Schools, the Anthropology Department, the Institute of Food and Agriculture Science, and the Dental and Nursing Schools. Specific courses include "Women, Mothers, and Midwives," which addresses women's health in a political and historical context; "From Dora to Prozac," which examines the representations of women and mental illness throughout history; and "Genes and Gender," a course that examines how stereotypes of gender differences inform science and necessitates a need for more "genetical literacy" so people can assess the scientific merit of subjects such as the Human Genome Project.

RESEARCH

In 2001 the Center submitted a proposal to the Luce Foundation for the study of gender and environment in Latin America and Africa.

CONFERENCES

The Center co-sponsors the annual "Leadership in Women's Health Conference" each year with their affiliated Center for Research on Women's Health at the University of Florida.

ILLINOIS

The University of Illinois at Chicago (UIC)

Center for Research on Women and Gender (CRWG)
1640 West Roosevelt Road, Room 503
Chicago, IL 60608-6902
DIRECTOR: Alice J. Dan, Ph.D.
PHONE: (312) 413-1924
FAX: (312) 413-7423
WEBSITE: http://www.uic.edu/depts/crwg/outline.htm

PROGRAMS

Women and Scientific Literacy

The program seeks to make science more attractive to women by expanding the content and teaching methods of the science curriculum in higher education, both within traditional science departments and within humanities and social science courses. This initiative brings together ten competitively chosen colleges and universities in a three-year curriculum and faculty development project. The Center encourages and supports collaborative research at the university through a variety of activities.

Breast Cancer Research Roundtable

The Breast Cancer Research Roundtable is a forum to foster on-going discussion about current ideas and research on breast cancer.

WEBSITE: http://www.uic.edu/depts/crwg/bcrsch.htm

This page is a new addition to the website of the Center for Research on Women and Gender (CRWG) and is the result of a Breast Cancer Research Roundtable sponsored by CRWG and held on February 27, 1998. Researchers from across the university with this common interest met to present their research and to share ideas. Currently this site contains the names, departments and presentation titles of the participants in the roundtable. More material will be added as the need arises.

The Research Information Network (RIN) for Women and Girls in Illinois

The RIN project maintains an on-line directory of resources for research information in the areas of care-giving, education employment, health, violence, policy, networks and special reports. Technology training sessions for grassroots organizations, legislators and their staff are available.

Women in Science and Engineering (WISE)

The WISE program was implemented at UIC to help determine and replicate best practices for helping women to succeed in science, engineering and mathematics careers. WISE also provides leadership opportunities for women in these fields at the undergraduate and graduate levels. Travel grants to national conferences in the fields of science, engineering and mathematics are also provided.

WISENET Bulletin
EMAIL: listerv@uic.edu

This bulletin board is maintained as an on-line communication tool for women in science and engineering programs throughout the country. The board is open to the public. To join, send an email with text in the body of the email that reads, 'subscribe WISENET your name.'

CONFERENCES
Young Women in Science and Technology

Co-sponsored by the Center for Research on Women and Gender, the conference was held in May 1999 for teachers and students K–12. Workshops provided an opportunity to reveal best practices in science and technology as well as opportunities to speak with successful female role models.

UNIVERSITY PROGRAMS
As part of the UIC National Center of Excellence in Women's Health, a leadership core that includes professional development for women in the health science was established in 1998. This core tracks and evaluates on-campus career development opportunities for women across the six health sciences schools: the Colleges of Dentistry, Health and Human Development Sciences, Medicine, Nursing, Pharmacy, and the School of Public Health.

Loyola University Chicago

Gannon Center for Women and Leadership
6525 North Sheridan Road
Sullivan 200
Chicago, IL 60626
DIRECTOR: Carolyn Farrell BVM
PHONE: (773) 508-8430
FAX: (773) 508-8492
WEBSITE: http://www.luc.edu/orgs/gannon

UNIVERSITY PROGRAMS
Women in Science Enabling Research (WISER)
WEBSITE: http://www.luc.edu/orgs/gannon/wiser.

The WISER program was designed in 1993 to provide freshman and sophomore women with an introduction to laboratory research and to create a community of scientists through which undergraduate women could be mentored and encouraged toward careers in the sciences.

The Laura L. Mayer Internship
WEBSITE: http://www.luc.edu/orgs/gannon/wiser.

The Laura L. Mayer Internship Program consists of summer research opportunities, visits to research laboratories on the university campus, four information discussion sessions with WISER faculty and a concluding lecture by a prominent woman scientist. The program provides a student stipend.

INDIANA

Girls Incorporated

National Resource Center
441 West Michigan Street
Indianapolis, IN 46202-3233
DIRECTOR OF RESEARCH: Heather Johnston Nicholson
PHONE: (800) 374-4475 or (317) 634-7546
FAX: (317) 634-3024
National Headquarters
120 Wall Street, 3rd Floor
New York, NY 10005
PRESIDENT/CEO: Joyce M. Roché
PHONE: (212) 509-2000
FAX: (212) 509-8708
EMAIL: girlsincorporated@girls-inc.org or girlsinc@girls-inc.org
WEBSITE: http://www.girlsinc.org

PROGRAMS
Girls Incorporated® Operation SMART℠
WEBSITE: http://www.girlsinc.org

Girls Inc. launched Operation SMART (Science, Math, and Relevant Technology) in 1985 to sustain girls' interest and participation in science, math and technology. This comprehensive, hands-on, inquiry-based program includes components for girls ages 6 to 18 including the 3 following programs.

Eureka!℠

This intensive four-week summer course and school year continuation program is conducted on a college campus with a year-round follow-up at the Girls Incorporated affiliate. Eureka! takes a "whole girl" approach that focuses on science, math, computers, sports, personal development and career orientation.

Girls Dig It℠: An Archaeology Program for Girls ages 12 to 14

Girls visit actual and virtual archaeological sites and work with practicing archaeologists to delve into this and other disciplines. They find and classify artifacts, interpret their findings and post their results on a protected website.

GirlsLink Gets SMART

Girls explore cyberspace, meet scientists online and explore math and science resources and careers in this program for middle school-age girls.

PUBLICATIONS

The Explorer's Pass: A Report on Case Studies of Girls and Math, Science and Technology

This 1991 report on naturalistic research in three Girls Inc. communities still communicates about the subtle and not-so subtle messages to girls about math, science and technology. Computers today are fancier, but many of the messages to girls have not kept up with changing technology.

Girls and Science and Math Fact Sheet

This publication presents the most recent research and statistics on school-age and teen girls' interest, scores and involvement in science and math.

Great Science, Math and Technology Web Sites for Girls

This publication includes Internet addresses and descriptions of science, math and technology web sites of interest to young people.

Girls and Information Technology Fact Sheet

This publication presents the most recent research and statistics on the role information technology plays in the lives of girls between the ages of 6 and 18.

LOUISIANA

Tulane University

Newcomb College Center for Research on Women
Caroline Richardson Hall
62 Newcomb Place
Tulane University
New Orleans, LA 70118
DIRECTOR: Beth Willinger
PHONE: (504) 865-5238
FAX: (504) 862-8948
WEBSITE: http://www.tulane.edu/~wc

PROGRAMS

Sophie B. Wired Computer Cluster Project

Opened to women's studies students and faculty, and to the Newcomb/Tulane community at large, in mid-August 1997, this cluster project is envisioned as a "feminist collaborative learning space." The cluster is part of the Center's initiative to extend the media literacy components of the Women's Studies Program curriculum to include new communications technologies, to empower students to access the wealth of information and perspectives available on the Internet and to encourage students to correct existing gender imbalance by representing themselves in emerging cyberspace.

I.M.A.G.I.N.E. Project (Internet Mentoring as Girls' Imagination-Nurturing Engine)

This program fosters the Internet presence of women and girls and increases girls' Internet skills. The 20-hour summer camp for local middle school girls helps girls explore through readings and the Internet how young women are represented and encouraged to be empowered to represent themselves and set goals for their futures. This program covers the basics of Internet navigation, online identity and basic website design, emphasizing how to use the Internet to help with college and career planning.

MARYLAND

University of Maryland

National Women's Studies Association
7100 Baltimore Boulevard, Suite 500
College Park, MD 20740
DIRECTOR: Loretta Younger
PHONE: (301) 403-0525
FAX: (301) 403-4137
EMAIL: nwsa@umail.umd.edu
WEBSITE: http://www.nwsa.org

OTHER UNIVERSITY PROGRAMS

Association for Women in Mathematics (AWM)
4114 Computer and Space Sciences Building
College Park, MD 20742-2461
PHONE: (301) 405-7892
FAX: (301) 314-9363
EMAIL: awm@math.umd.edu
WEBSITE: http://www.awm-math.org

Founded in 1971, this organization publishes a substantial and broadly informative newsletter and a mailing list. Its programs and awards include Travel Grants for Women, the Noether Lecture Series, Workshops for Women Graduate Students and Post-Doctoral students, the Alice T. Schafer Mathematics Prize, the Louise Hay Award, the annual Joint Mathematics Meetings and the annual SIAM Meeting, the Sonia Kovalesky High School Mathematics Days, and information on conferences organized by AWM. The site includes expanded versions of some newsletter articles, on-line forums on various topics, information about all AWM activities, and links to other sites concerning women and mathematics.

Women in Mathematics (WIM)
EMAIL: wim@math.umd.edu
WEBSITE: http://www.math.umd.edu/~wim

Women in Math (WIM) is dedicated to serving the needs of women mathematicians at UMCP. In order to fulfill that purpose, WIM members have organized a number of events. Two ongoing activities are monthly lunch get-togethers and biweekly graduate women talks. They also have an electronic newsletter for their members. WIM's website is their latest endeavor. It includes many resources for women studying and working in mathematics.

MASSACHUSETTS

Harvard University
John F. Kennedy School of Government

Women and Public Policy Program
79 John F. Kennedy Street
Cambridge, MA 02138
DIRECTOR: Swanee Hunt
FACULTY CHAIR: Jane Mansbridge
EXECUTIVE DIRECTOR: Victoria Budson
PHONE: (617) 496-6973
FAX: (617) 496-6154
EMAIL: wappp@ksg.harvard.edu
WEBSITE: http://www.ksg.harvard.edu/wappp

PROGRAMS

Women in the Information Age

This research and policy project analyzes the participation and retention of women in IT-related fields and delineates the roles women must play to help shape the construction of an Information Society. The mission of the project is three-fold: to advance opportunities for women as experts, designers, controllers and users of new technologies; to broaden and enrich the scope of information technologies by increasing women's participation in their design; and to build and facilitate global networks through collaborations with international projects at the Kennedy School. A book is forthcoming entitled *Women in the Information Age* by Professor Jane Fountain, Director of the Women in the Information Age Study. The digital policy platform designed by the Women in the Information Age Project can be found at www.ksg.harvard.edu/witia. This project is in collaboration with the Harvard Information Infrastructure Project.

Harvard University
Radcliffe Institute for Advanced Study (RIAS)
The Radcliffe Public Policy Center (RPPC)

69 Brattle Street
Cambridge, MA 02138
EXECUTIVE DIRECTOR: Paula Rayman
PHONE: (617) 496-3478
FAX: (617) 496-2982
EMAIL: rppc@harvard.edu
WEBSITE: http://www.radcliffe.edu/pubpol/index.html

PROGRAMS

Science, Society and Gender

In recognition of the profound social and economic impact of advances in science and technology, RPPC has chosen science, society and gender as a major research theme, building on projects that have been part of the Center's program since 1996. The center's research focuses on the relationship between the advancement of women in science and the advancement of science itself. A distinguished research advisory group of Harvard University faculty scientists and leaders from scientific industries helps define the research agenda. Specific research projects address the culture of scientific laboratories and workplaces, gender issues in information technology design and implementation, and the future of science education and scientific careers.

Professional Pathways: Examining Work, Family and Community in the Biotechnology Industry, 1997–1999

The Alfred P. Sloan Foundation funded this two-year-long study of work, family and community issues affecting technical and professional employees in the biotechnology industry. The project's research team sought to gain a greater understanding of what opportunities and constraints confront biotech professionals seeking to integrate their work lives with their family and community commitments. In addition, the team sought to understand how professional workers in this relatively new industry handle the absence of long-term job security and predictability that is inherent in biotech work. This project drew on approaches from several disciplines—anthropology, sociology, psychology and economics—to paint a multidimensional portrait of biotech professionals in their professional environments, as well as at home and in their communities.

Women in Information Technology Workplaces: A Study Of Women Computer Science Degree Recipients In the Software Industry.

The NSF-funded program will investigate the factors affecting the attraction, retention, and promotion of women in IT by comparing female and male professionals who hold bachelor's, master's or Ph.D. degrees in Computer Science/Computer Engineering (CS/CE) and who work in software and Internet companies. The project will explore issues such as: the economic security, job stability and career pathways of IT workers; the design of work in IT organizations; the impact of temporary, part-time and contract work on women in IT; the evaluation, training, and reward structures of IT; the implicit and explicit values in the IT design process and products.

Mount Holyoke College

Five College Women's Studies Research Center
Dickinson House
South Hadley, MA 01075
DIRECTOR: Gail Hornstein
PHONE: (413) 538-2275
FAX: (413) 538-2082
WEBSITE: http://www.mtholyoke.edu/

PROGRAMS

Speaker Series: "Feminism and Science: Neural Geographies, Digital Anatomies and Reproductive Choreographies"

This series features three feminist scholars whose research is contributing to a reconfiguration of the terrain of feminist science studies. The premise of the series is that feminist science studies is a mutually productive, complex, respectful, provocative and challenging conversation engaging science and feminist scholarship. Future speakers include Donna Haraway and Emily Martin.

GenderWise

The GenderWise Working Conference has been held during July on the campus of Mount Holyoke College for the past five years. Initiated through funding by the National Science Foundation's Model Projects for Women and Girls Program, GenderWise has allowed 20–25 high school and college teachers, administrators and program developers to come together to discuss and experience ways to encourage young women to become more invested and engaged in their mathematics studies.

SummerMath
Mount Holyoke College
50 College Street
South Hadley, MA 01075-1441
DIRECTORS: Charlene and James Morrow
PHONE: (413) 538-2608
FAX: (413) 538-2002
EMAIL: summermath@mtholyoke.edu

SummerMath is a four-week program for girls in the eighth through twelfth grades. It encourages and helps students to strengthen their mathematical thinking and communications skills, develop problem solving strategies and computer skills and build their confidence. SummerMath workshops are intended to bring mathematics to life for students. Each student participates in two different two-week workshops for 90 minutes each day. The emphasis is on hands-on experience, so students can see how things work, while exploring connections with mathematics. Workshops for SummerMath 1999 were Architecture and Math, Origami, Medical Ethics, Economics, Kite-Making and Aerodynamics, Optimization, and Biology of Genetics and Growth.

SummerMath for Teachers
DIRECTORS: Virginia Bastable and Jill Bodner Lester
PHONE: (413) 538-2063
FAX: (413) 538-2002
EMAIL: smt-dmiinfo@mtholyoke.edu

SummerMath for Teachers (SMT) is an in-service teacher education program established at Mount Holyoke College in 1983. Originally designed to offer summer institutes to secondary school mathematics teachers, the program has expanded to include four two-week summer programs for teachers of grades K–12 and academic year courses and seminars in mathematics education for teachers and administrators. In addition, SMT is a site for educational research through multi-year programs funded by the National Science Foundation.

Smith College

Project on Women and Social Change
Seelye Hall, Room 210
Northampton, MA 01063
CO-DIRECTOR: Christine M. Shelton
CO-DIRECTOR: Myron Peretz Glazer
PHONE: (413) 585-3591
FAX: (413) 585-3593
EMAIL: kgauger@-smith.edu
WEBSITE: http://smith.edu/wsc

OTHER PROGRAMS

Program in the History of Science and Technology
Seelye Hall, Room 210
Northampton, MA 01063
PHONE: (413) 585-3591
FAX: (413) 585-3593
EMAIL: kgauger@smith.edu
WEBSITE: http://smith.edu/hsc

The history of science and technology links many disciplines and cultures: scientific, technological, humanistic and social. Courses in the program examine science and technology in their cultural and social contexts, and the ways in which scientific inquiries, achievements and debates have shaped and continue to shape human culture (and vice versa).

Picker Program in Engineering and Technology
Northampton, MA 01063
PHONE: (413) 585-7000
EMAIL: Principia@science.smith.edu
WEBSITE: http://www.science.smith.edu/departments/Engin/

CONFERENCES

Designing the Future
March 30–31, 2001

Established in 1999, Smith's engineering program is the first such program at a women's college and one of only a handful at liberal arts colleges. To celebrate the launch of its Picker Engineering Program, Smith College hosted educators and prominent engineering executives for a discussion

of new approaches to undergraduate engineering education with a focus on strategies and policies for encouraging women and other underrepresented groups to pursue careers in technology. More than 250 corporate representatives, deans of engineering schools, faculty members, representatives of accrediting organizations and alumnae participated in the summit on engineering education, which focused on strategies and policies that encourage women and other underrepresented groups to pursue careers in technology.

Executive Access: Top Engineering Professional Share their Work and Insights

The goal of this lecture series, sponsored by the Picker Engineering Program and Ford Motor Company, is to get students excited about engineering and to offer them inspirational role models by hosting distinguished engineering professionals who are innovators in their fields. The speakers come from diverse backgrounds, representing the corporate world, academia and public health.

Smith Summer Science and Engineering Program
Clark Science Center
Smith College
Northampton, MA 01063
PHONE: (413) 585-3060
EMAIL: info@summerscience.smith.edu
WEBSITE: http://smith.escapecs.com/

PROGRAMS

SummerScience

For 11 years, Smith College's Summer Science and Engineering Program has brought promising, highly motivated students to its campus for a month-long stay designed to boost their confidence in studying the sciences. The middle and high school students in the program get to use state-of-the-art equipment in Smith's Clark Science Center. Students can take one four-week course or two two-week courses. There are no exams or grades, but each student gives two oral presentations. They can also invite a teacher to listen to the presentation for "Visiting Teacher Weekend."

Smith College Summer Institute for Educators
WEBSITE: http://www.smith.edu/summerprograms/educators

Smith College hosts a three-day conference for pre-college educators each July. By exploring the myriad of challenges pre-college girls face in their daily lives, this conference aims to help teachers effectively encourage girls in middle and high school. The Summer Institute's major goal is to promote changes in teaching and counseling practices in order to better encourage girls' achievement in academic fields where women are currently underrepresented like science, math, engineering and technology. Professional Development Points are awarded to Institute participants. Details can be obtained from the website.

Wellesley College

The Wellesley Centers for Women
Center for Research on Women
106 Central Street
Wellesley, MA 02481
DIRECTOR: Susan McGee Bailey
PHONE: (781) 283-2500
FAX: (781) 283-2504
WEBSITE: http://www.wcwonline.org

PROGRAMS

Summer Seminar on Gender Issues

A summer seminar on gender issues in science teaching, funded by a grant from the Howard Hughes Medical Institute, was offered to middle school, junior high and high school science teachers for three consecutive summers, beginning in 1997.

PUBLICATIONS

The Girls' Coalition Newsletter
Vol. 7, Issue 3, Spring 2000
WEBSITE: www.girlscoalition.com

This issue is focused entirely on girls and science and includes a resource/reference list on the subject.

Pathways for Women in the Sciences: The Wellesley Report, Part I, 1993

This report is the first phase of a longitudinal study addressing why women choose to enter scientific fields and what promotes or impedes their success.

Pathways for Women in the Sciences, Part II: Retaining Women in Math and Science in College and Beyond, 1997

This second phase of the *Pathways* longitudinal study examines persistence in science in college and beyond. Additionally, the report contains the results of an extensive survey of women in scientific and non-scientific fields. It focuses on the experiences of women in the scientific workplace and issues related to balancing work and family life.

MICHIGAN

University of Michigan

Center for the Education of Women (CEW)
330 East Liberty
Ann Arbor, MI 48104
DIRECTOR: Carol Hollenshead
PHONE: (734) 998-7240
FAX: (734) 998-6203
WEBSITE: www.umich.edu/~cew

PUBLICATIONS

The Equity Agenda: Women in Science, Mathematics and Engineering

This full-color, 13-page report, published by the Cross University Research in Engineering and Science (CURIES) is a summary of research and policy recommendations from a national conference on gender issues in science,

mathematics, and engineering. The University of Michigan and the University of Washington, Wellesley College and Carnegie Mellon University jointly produced it, supported by a grant from the Sloan Foundation.

The Equity Equation: Fostering the Advancement of Women in the Sciences, Mathematics and Engineering, 1996
AVAILABLE FROM: *Jossey-Bass, publishers.*

Jointly edited by Cinda-Sue Davis (Director of Women in Science and Engineering at the University of Michigan), Carol Hollenshead (Director of the Center for the Education of Women at the University of Michigan), Angela Ginorio (Director of the Northwest Center for Research on Women at the University of Washington), Barbara Lazarus (Associate Provost for Academic Projects at Carnegie Mellon University), and Paula Rayman (Director of the Radcliffe Public Policy Center at Harvard University), this book presents an analysis of the diverse issues facing women in science and engineering, from K–12 education to higher education to professional careers.

The Michigan Faculty Work-Life Study, 2000
WEBSITE: http://www.umich.edu/~cew/pubs.html

Provides analysis of the findings of a survey of over 1,000 University of Michigan faculty members, including those in science related fields concerning career satisfaction. Included were questions of climate issues, organizational structure, policies and resources, workload and productivity, family work-life iss es, and career satisfaction and retention. The summary, full report and tables are all available online.

A Survey of the Graduate Experience: Sources of Satisfaction and Dissatisfaction Among Graduate Students at the University of Michigan

Identifies those features of the academic climate that promote a positive graduate experience, as well as those which contribute to feelings of alienation and/or dissatisfaction.

UNIVERSITY PROGRAMS

Women in Science and Engineering (WISE)
1065 Frieze Building
105 State Street
Ann Arbor, MI 48109-1285
DIRECTOR: Cinda-Sue Davis
PHONE: (734) 615-4455
EMAIL: umwise@umich.edu
WEBSITE: http://www.umich.edu/~umwise

Women faculty members in the sciences and engineering established the WISE Program in 1980. The WISE program works to increase the number of women students who choose majors, advanced degrees, and careers in science, engineering and mathematics and seeks to ensure that every woman with the potential and interest in such a career has the necessary background and support to pursue these interests. In order to reach this goal, the WISE Program offers many different programs and resources for K–12, undergraduate and graduate students. WISE also conducts research on issues facing women in science and engineering and advocates for women students.

Future Science: Future Engineering

For girls currently in the seventh or eighth grades interested in science and engineering, WISE offers a one-week day program in June in Ann Arbor. Each day includes hands-on laboratory experimentation, computer simulation activities and introductions to online network systems. Girls can explore the world of ultra-fast optics, learn what DNA reveals, experiment with chemical compounds, build and launch a rocket or unlock the secrets of the universe through physics. In addition to lab activities, girls meet women scientists and engineers and learn about careers of the future.

The Women in Science and Engineering Undergraduate Internship Program

Directed by the Undergraduate Research Opportunity Program, this program uses funds from the College of Literature, Science and the Arts to place freshman and sophomore women in the laboratories of women scientists. Students conduct their own research projects and participate in several career workshops.

Marian Sarah Parker Scholars Program

This is an honorary program designed to inform, encourage and support high-achieving undergraduate women in the career/graduate school decision-making process. Parker Scholars attend workshops focusing on graduate school, research careers and planning their futures and participate in academic research internships in the summer or fall terms. Participation in the Parker Scholars Program is an honor recognized by the College of Engineering and can be a personally and professionally rewarding experience.

WISE Residential Program

The living-learning programs at the WISE Program and the Undergraduate Research Opportunities Program (UROP) have been jointly recognized by the National Science Foundation for their excellence in integrating research and undergraduate education. The programs received a $500,000 NSF Recognition Award for Integration of Research and Education (RAIRE) to expand and disseminate information about their successful residential programs.

Graduate Experience Project
WEBSITE: http://www.umich.edu/~gep

The Graduate Experience Project was initiated, with the assistance of the Alfred P. Sloan Foundation, to improve the recruitment and retention of women graduate students in the engineering, physics, applied physics and chemistry disciplines at UM. This collaborative effort draws on the University's strong academic and research backgrounds to evaluate the reasons why women graduate students select to attend the University and whether they leave prior to degree completion. This information is used to develop interventions, systemic or not, to assist women reach their academic and professional potential.

PUBLICATIONS
Resource Guides

The WISE Program produces and distributes a variety of resource guides for students including a "List of National Organizations of and for Women in Science and Engineering," a "List of Organizations of and for Women in Science and Engineering at The University of Michigan," a "Bibliography of Career Information in the Sciences," "Student Services and Placement Offices in Science and Engineering at The University of Michigan," and the "Women in Science and Engineering Resource Locator" a list of women scientists who have volunteered to talk to students about various science departments, majors and careers.

University of Michigan
Institute for Research on Women and Gender
1136 Lane Hall
204 S. State Street
Ann Arbor, MI 48109-1290
Abigail J. Stewart, Director
PHONE: (734) 764-9537
FAX: (734) 764-9533
WEBSITE: http://www.umich.edu/~irwg/index.html

PROGRAMS
Using Math—Girls Investigate Real Life (U-M GIRL)

U-M GIRL is a program designed to reach sixth grade girls who are losing interest in math and science. It is both an intervention program for sixth grade girls under-performing in math and a professional development program for middle school math and social studies teachers. The philosophy of U-M GIRL emphasizes long-term involvement with both the girls and their teachers; facilitates collaboration among local schools, school boards, the University of Michigan, and individual students and families; targets girls at the grade level at which they start to fall behind; and gets the girls involved by connecting math instruction to the girls' own experiences of adolescence and the world in which they live.

NEW JERSEY

Rutgers University
The Center for Women and Work
Ruth Dill Johnson Crockett Building
Douglass Campus, Rutgers
The State University of New Jersey
162 Ryders Lane
New Brunswick, NJ 08901
DIRECTOR: Barbara A. Lee
PHONE: (732) 932-1463
FAX: (732) 932-4739
WEBSITE: http://www.rci.rutgers.edu/~cww/index.html

RESEARCH
The Rutgers Databank on Working Women

The Center for Women and Work is currently conducting research for the New Jersey Council on Gender Parity in Labor and Education on gender inequity within the technological and science sector of the United States labor market, specifically in New Jersey. The databank includes the most recently available data from the United States government on issues related to working women.

Questions or comments about the databank should be directed by email to Mary Gatta at gatta@rci.rutgers.edu

Rutgers University
Institute for Women's Leadership
Douglass College, Rutgers
The State University of New Jersey
50 Bishop Street
New Brunswick, NJ 08901-8530
DIRECTOR: Mary Hartman
PHONE: (732) 932-9197, ext. 10
FAX: (732) 932-1533
EMAIL: dougproj@rci.rutgers.edu
WEBSITE: http://www-rci.rutgers.edu/~dougproj

DOUGLASS COLLEGE PROGRAMS
Douglass Project for Rutgers Women in Math, Science and Engineering

The Douglass Project offers programs and services to inspire and develop the potential of pre-college, undergraduate, and graduate women as they explore science and technology. These initiatives prepare girls and young women to become leaders in a dynamic and diverse society. To realize this goal, the Douglass Project focuses on academic enrichment and personal development activities.

Douglass Science Institute Program Series (DSI)

DSI is a four-year summer residential program for young women entering ninth grade who want to explore a variety of areas in science, math and engineering. During hands-on labs, workshops and field trips, students explore new horizons in these technical areas and find out how to build a future around them. Participants also learn about career options in math, science and engineering by talking with undergraduates, Rutgers University faculty and women working in the corporate world. The program aims to create an exciting and supportive environment to nurture students intellectually, creatively and socially. Participating students are encouraged to share their ideas and work cooperatively

with new friends both in the classroom and through informal group activities.

Douglass Science Weekend Academy

The Douglass Project Weekend Academy offers students opportunities to explore the life sciences, physical sciences and mathematics through labs and workshops. The Weekend Academy is held on three consecutive Saturdays during the fall. High school teachers and Rutgers University faculty and students lead hands-on activities highlighting areas such as biology, ceramic engineering, chemistry, math and physics. The Academy is offered to ninth and tenth grade girls attending schools in Mercer, Middlesex, Somerset and Union counties in New Jersey.

Douglass Science Career Exploration Day

Douglass Science Career Exploration Day is designed for 11th and 12th grade students who are interested in exploring careers related to mathematics, the sciences and engineering. The program features outstanding guests from the scientific research community who speak on relevant topics. Students participating in the program meet and talk with women role models who have excelled in the fields of math, science and engineering, and learn about their educational experiences, career-related activities and research projects. Fields represented include biochemistry, pharmacology, chemistry, environmental sciences, molecular biology, physics, mathematics, plus all disciplines of engineering. Informative workshops that help shed light on the college admissions process, financial aid availability and issues of educational equity are offered to parents, also.

Douglass Project Outreach Program

The Outreach Program is a community service project that fosters involvement in math and science education, and provides positive role models to children in elementary and middle schools. Undergraduate volunteers lead hands-on science activities in public school classrooms, chaperone field trips and assist with science fairs.

Leading Young Women to the Sciences and Technology (and The Girl Scouts Leadership Institute in Science and Technology)

EMAIL: dawnas@rci.rutgers.edu
WEBSITE: http://www.rci.rutgers.edu/~mclarke/index.html

"Leading Young Women to the Sciences and Technology" is a new collaboration between Douglass College, Rutgers, The State University of New Jersey, and the Girl Scouts of the U.S.A. This is a residential program specially designed to encourage young women to explore the fields of mathematics, science, engineering and technology.

Science for Undergraduates: A Program for Excellence in Research (SUPER)

Project SUPER is an innovative program that engages first-year Douglass College women and College of Engineering women who reside at Douglass College in a challenging series of co-curricular activities. This yearlong program is designed to enrich academic performance and expand knowledge of research and career opportunities in the physical sciences, engineering and the life sciences.

Douglass Project Student Programming Council

The Student Programming Council offers undergraduates the opportunity to develop leadership skills, establish peer networks and have an impact on their own college experience. Student committees plan and develop programs for fellow undergraduates in math, science and engineering fields. Council initiatives have included newsletters, faculty/student teas, internship resources, graduate school information and the creation of the Douglass Project Alumnae Network.

Douglass Project Outreach Program

Student Partners in Science offers undergraduates the opportunity to engage in community service by leading hands-on science activities.

Internship/Research Information Center

The Douglass Project Resource Center provides undergraduate women with information about university, industrial and other research opportunities and includes summer research stipends for Douglass students who do summer research in university laboratories.

Career Exploration Sessions

Women can explore many options by attending evening lectures, panel presentations and weekend workshops on career topics that feature guest speakers from the scientific community and students from graduate and professional schools. The programs help to empower women by focusing on skill development, interview techniques and career options in math, biology, chemistry, engineering, physics, computer science, allied health and other fields.

Peer Study Sessions

Peer Study sessions, led by Bunting-Cobb Graduate Fellows, are designed to help students learn more effectively by encouraging active participation in group discussion of topics covered in class. Subjects usually covered include biology, pre-calculus, calculus, chemistry, organic chemistry and physics.

Bunting-Cobb Math, Science and Engineering Residence Hall and Graduate Fellowship Program

PHONE: (908) 932-9197
WEBSITE: http://www-rci.rutgers.edu/~dougproj/ProgServ.html#PS

Bunting-Cobb provides 100 undergraduate women majoring in math, science and engineering with the opportunity to live in a dedicated residence hall with female graduate students in various relevant disciplines. Graduate students living in Bunting-Cobb provide support to undergraduates by coordinating academic-related programs, organizing peer study sessions, mentoring students with similar academic interests and helping students to reach their academic goals. Bunting-Cobb includes a science library and its own computer facility, which provides Internet access and is connected directly into the Rutgers University Network.

NEW YORK

Catalyst

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New York, NY 10005
PRESIDENT: Sheila Wellington
PHONE: (212) 514-7600
FAX: (212) 514-8470
CANADA OFFICE: 110 Yonge Street
11th Floor
Toronto, ON M5C1T4
PHONE: (416) 815-7600
EMAIL: info@catalystwomen.org
WEBSITE: http://www.catalystwomen.org

PUBLICATIONS

Women in Information Technology, Catalyst Infobrief, 1999

AVAILABLE ONLINE: http://www.catalystwomen.org/press/infobriefs/infombatech.htm

This document demonstrates that although information technology is a burgeoning field with the potential for a level playing field and higher-than-average pay scales, there are fewer women working in IT professions than ever before and fewer young women entering the IT pipeline than in the past.

Women Scientists in Industry: A Winning Formula for Companies, 1999
WEBSITE: http://www.catalystwomen.org/press/factsheets/factsscience.html

The study, based on in-depth interviews with 30 leading women scientists, finds that over half report that they were given little or no information about the corporate job market for industrial science careers. The report contains profiles of the scientists, outlines the barriers to women's advancement in the sciences, success strategies, recommendations for companies and individual women, and recognizes the corporations with the 'best practices.' The report is available from Catalyst. Select profiles are accessible online.

City University of New York, Graduate School and University Center

Center for the Study of Women and Society
365 Fifth Avenue, 5th Floor
New York, NY 10016
DIRECTOR: Patricia Clough
PHONE: (212) 817-8895
FAX: (212) 817-8905
WEBSITES: http://web.gc.cuny.edu/womencenter and http://web.gc.cuny.edu/womenstudies/

PROGRAMS

Symposia on the Relationship between Feminist Scholarship and Technoscientific Production

An ongoing symposium program that includes topics such as Tiny Bombs: Quinacrine, National Security, and the Global Politics of Population Control; Rethinking Feminist Anthropology from Gender to Genome; and On Networked Intelligence and the Digital Economy: Thinking About College Politics in Control Societies.

Studying the Web and Learning on the Web

A joint project of the Center for the Study of Women and Society and the Center for the Study of Culture, Technology and Work at CUNY, the New School University, and universities in Rome, São Paulo and Budapest. The project is directed by Patricia T. Clough and Stanley Aronowitz.

Cornell University

Institute on Women and Work
New York School of Industrial and Labor Relations
16 East 34 Street, 4th Floor
New York, NY 10016
DIRECTOR: Francine Moccio
PHONE: (212) 340-2836
FAX: (212) 340-2822
WEBSITE: http://www.ilr.cornell.edu/women&work

UNIVERSITY PROGRAMS

Women in Science and Engineering Resource (WISER)
WEBSITE: http://www.englib.cornell.edu/wiser

WISER aims to ensure a positive experience in science for women students at Cornell, and to provide resources for women in science and engineering.

The WISER Center

A mentoring center staffed by women upperclassmen, graduate students and postdocs. The focus is directed towards women in their first two years of science.

WISER Lecture Series

WISER sponsors two symposiums per semester.

Into the Labs Tour

WISER members take students into their labs to show them the possibilities for research at the undergraduate and graduate levels.

The Feminist Press

365 Fifth Avenue, 5th Floor
New York, NY 10016
PUBLISHER/DIRECTOR: Jean Casella
PHONE: (212) 817-7920
FAX: (212) 987-4008
WEBSITE: http://www.feministpress.org

PUBLICATIONS

Building Inclusive Science: Connecting Women's Studies and Women in Science and Engineering, Women's Studies Quarterly 28, Nos. 1 & 2, Spring/Summer 2000, Sue Rosser (Ed.)

Women have always been scientists, but over the centuries, their contributions have been unrecognized, limited and thwarted by unequal resources and opportunities. While conditions have improved, crucial questions remain: Why do talented women infrequently pursue careers in fields such as computer science and engineering? Does science education privilege an inflexible epistemology that may alienate women? Are the sciences disconnected from contemporary society? How has feminism changed scientific practice? This issue of *Women's Studies Quarterly* broadens the dialogue between women's studies and the sciences and explores new methods and approaches to reduce the masculine bias in scientific inquiry and science classrooms. Contributors to this issue come from a broad range of disciplines, representing bioethics, physics, biology, computer science, engineering and more.

FORTHCOMING: *"Women Confronting the New Technologies,"* Women's Studies Quarterly 29, Nos. 3 & 4, Fall/Winter 2001, Lee Quinby (Ed.)

Girls Incorporated

(SEE INDIANA)

Girl Scouts of the U.S.A.

420 5th Avenue
New York, NY 10018-2798
NATIONAL EXECUTIVE DIRECTOR:
Marsha Johnson Evans
PHONE: (800) GSUSA-4U
EMAIL: program@girlscouts.org *or*
misc@girlscouts.org
WEBSITE: http://www.girlscouts.org

PROGRAMS

GirlFACTS (Girls, Families and Communities Together in Science)

GirlFACTS is a national project that encourages family involvement in girls' science learning. The program, funded by Lucent Technology, provides opportunities for nine through thirteen year-old girls, and their parents and adult guardians to investigate the world around them through hands-on science, math and technology activities in the community and at home.

Intel/"Fair Play"

"Fair Play," made possible by a grant from the Intel Foundation, encourages Girl Scouts going into the ninth grade to develop their knowledge of science, technology and related skills. The funding will support local summer camps and workshops, promoting individual and team science projects over the next year. The camps will be held at ten Intel facilities around the country, working with local councils. Instructors and mentors from Intel will guide the girls and support their projects' entry into local science fairs. At the end of the summer camps, all the girls will have the opportunity to enter a local Intel International Science and Engineering Fair (Intel ISEF) in May 2002.

Lockheed Martin Career Exploration Fund

The Fund, begun in 1998 with a grant from the Lockheed Martin Corporation, enables Girl Scout Councils nationwide to develop unique and innovative projects in science, math and technology. So far over 12,000 girls have participated in activities focusing on areas ranging from archeology to outer space.

National Science Partnership for Girl Scouts and Science Museums (NSP)
WEBSITE: http://sln.fi.edu/tfi/programs/nsp.html

The Girls Scouts of the United States of America and The Franklin Institute jointly administer NSP. This program seeks to increase opportunities for girls, ages six through twelve, to explore the knowledge and processes of science in a hands-on, exploratory, all-girl environment. The NSP builds the confidence and self-esteem of young women through positive experiences with science and technology and promotes their interest in science careers. The strength of NSP rests in the program's hands-on kits, the training opportunities and the partnership between Girl Scout councils and science institutions.

Hamilton College

The Kirkland Project for the Study of Gender, Society and Culture
198 College Hill Road
Clinton, NY 13323
PROJECT COORDINATOR: Nancy Rabinowitz
PHONE: (315) 859-4149 *or* 859-4288
FAX: (315) 859-4390
EMAIL: Kirkproj@hamilton.edu
WEBSITE: http://academics.Hamilton.edu/organizations/Kirkland

PROGRAMS

Girls and Women in Science (GWIS)

This program brings adolescent girls and their teachers to campus.

"Communicating Science" (Fall 1998)

This conference examined the mechanisms by which science is communicated to various audiences, and considered the outcomes and consequences of this interaction. The conference examined how to define and evaluate the problems encountered in the dissemination of scientific knowledge, and sought to develop strategies for more effective communication within the scientific community, with students, within the academy, and with the general public.

"The Fight Against Breast Cancer: Who's in Charge," 1998–99

A series of meetings about breast cancer convened for students, faculty and broader community of the Mohawk Valley. It featured talks by activists and included a panel of doctors and survivors and a night of films.

FORTHCOMING:
"The Body," 2001–02
"Technology and Democracy," 2003
Please contact the Kirkland Project for more information.

Marymount College

Marymount Institute for the Education of Women & Girls
100 Marymount Avenue
Tarrytown, NY 10591-3796
DIRECTOR: Ellen S. Silber, Ph.D.
PHONE: (914) 332-4917
EMAIL: worninst@mmc.marymt.edu
WEBSITE: http://www.marymt.edu/~worninst and http://www.marymt.edu/~dome/women.html

PROGRAMS

International Paper Math and Science Scholars Summer Workshop

A two-week workshop designed as an educational experience to inspire young women entering grades 10–12 to continue their study of math and science and to consider careers in these areas.

CONFERENCES

The College and Institute sponsor a series of conferences on various issues, often intersecting with scientific and technological issues, that are designed to help teachers, administrators, parents, policy makers and students facilitate positive transformations in the classroom. For example, in 1998, *Women and Girls Connecting with Science* featured Anne Fausto-Sterling as the keynote speaker.

Young Women's Christian Association of the USA (YWCA)

350 Fifth Avenue, Suite 301
New York, NY 10118
CHIEF EXECUTIVE OFFICER:
Margaret A. Tyndall, Ph.D.
PHONE: (212) 273-7800
FAX: (212) 273-7806
WEBSITE: http://www.ywca.org

PROGRAMS

TechGYRLS

TechGYRLS raises girls' interest, confidence and competence in the crucial area of technology, while helping to develop critical thinking and problem solving skills. This initiative gives girls ages nine through thirteen a chance for hands-on exploration of different technologies with the encouragement of women established, and college women emergent, in the field of technology. The goal is to broaden girls' knowledge and interests, to help girls develop the confidence to use technology tools in whatever profession they pursue, and to discover links between enjoyable technology projects and academic subjects in science and math.

TechGYRLS Day

An annual hands-on technology day of fun and learning for girls and their college mentors. Activities designed for girls of varying ages and levels of expertise entice, encourage and challenge both girls and mentors to try different equipment and new ideas. The girls engage in internet scavenger hunts, design computers and explore electronics and robotics.

TechGYRLS Clubs

This program gives girls a chance to invent, design and present their own work in the context of learning life skills. Individual and group projects help develop communication, critical thinking, time management and presentation skills.

NORTH CAROLINA

Duke University

Women's Studies
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Durham, NC 27708
DIRECTOR: Jean O'Barr
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FAX: (919) 684-4652
EMAIL: wstprog@duke.edu
WEBSITE: www.duke.edu/womstud

PROGRAMS

Gender and Science Research Award

Open to graduate students whose projects promote scholarly exploration and research on the intersection of gender and science, math or engineering. The award is one-time grant of up to $1,500.

COURSES

The Women's Studies department offers several courses, often cross-listed with other departments, including "The History of Women in Science and Medicine," "Cyborgs and Their Dilemmas," "Aging and Health," and "Race and Medicine: Historical Perspectives." Check with the department for each semester's listings.

OHIO

University of Cincinnati

Center for Women Studies
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Cincinnati, OH 45221
155 McMicken Hall
ACTING DIRECTOR: Lisa Maria Hogeland
PHONE: (513) 556-6776
FAX: (513) 556-6771
EMAIL: womens.studies@uc.edu
WEBSITE: http://ucaswww.mcm.uc.edu/womens_studies

PROGRAM

Women in Science and Engineering (WISE)

The Center for Women's Studies at the University of Cincinnati, in collaboration with faculty from various scientific disciplines, is helping to develop a Women in Science and Engineering (WISE) Program. The program offers summer placements for undergraduate women students in science and engineering labs, and sponsors speakers at UC's campus. A mentoring program is also being developed. It is envisioned as a program that will provide an environment for women in science and engineering to attain their full potential as students and faculty, and will seek to engage women students in activities with faculty and peers to promote their success in the science and engineering professions.

Kent State University

College of Education, Project on the Study of Gender and Education
405 White Hall
P.O. Box 5190
Kent, OH 44242-0001
PROJECT DIRECTOR: Averil McClelland
PHONE: (330) 672-2294
FAX: (330) 672-2512

PROGRAMS

Ameritech Electronic University School Classroom

The Ameritech classroom is a state-of-the-art classroom especially designed to incorporate many kinds of electronic and other media into instruction. Students and their teachers in K–12 from area schools spend half days learning to use cutting-edge technology tools. Researchers in the attached observation room study the impact of technology integration from a variety of perspectives. The Ameritech Foundation funds the program, with additional support provided by the Martha Holden Jennings Foundation's University Council for Teaching.
Further information about on-going research may be obtained from Dr. Gay Fawcett, 412 White Hall, Kent State University, Kent, OH 44242.

Schoolnet Classrooms

Schoolnet is the Ohio initiative to put at least five computers in every classroom in the state. The Schoolnet classrooms in the College of Education are classrooms in which there are also five computers, and have been established to prepare all teacher education students in the college to work effectively in Ohio classrooms.

Linking The Future To The Present Project

This project is part of a national PT3 (Preparing Tomorrow's Teachers To Use Technology) initiative. The project provides support and resources to all arts and sciences and education faculty who participate in the preparation of pre-service teachers and are trying to integrate technology in their instruction in ways that will change how students think about and do their work. In addition, PT3 includes thematic "Triads," in which at least three different groups are represented—arts and science faculty members, college of education faculty, classroom teachers. Triads exist in science and mathematics.

Research Center For Educational Technology (RCET)
WEBSITE: http://www.rcet.org

In response to a recent study conducted by the U.S. Department of Education, which found that less than one quarter of teachers surveyed felt prepared to use technology in their classrooms, Kent State designed an evaluation of its progress in preparing teachers to use modern technology. With the help of a grant from Amentech, and as a result of a partnership in the new federal technology innovation challenge grant, the research center for educational technology supports research and evaluation projects designed to help the U.S. Department of Education, the U.S. Congress, other colleges of education, school districts and the public to learn what worked, what did not work, what conditions are required to replicate successful approaches in other settings, and what the impact technology has on teaching and learning.

Ohio State University

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Columbus, OH 43210
CHAIR: Valerie Lee, Ph.D.
PHONE: (614) 292-1021
FAX: (614) 292-0276
WEBSITE: http://womens-studies.ohio-state.edu

PUBLICATIONS

Reading Women's Lives Electronic Database
WEBSITE: http://womens-studies.ohio-state.edu/general/publicat.htm

This is a database of over 300 articles, essays and poems from which instructors can select to create customized readings for introductory Women's Studies courses. Readings are distributed over 18 themes, including Science, Gender and Technology; and each theme is

accompanied by an introductory essay by an OSU faculty member. A CD-ROM containing the entire database is available free of charge from the publisher. Details are available from the website and from the Department.

PROGRAMS

The department offers "Gender and Science" a cross-listed course with the Division of Comparative Studies, which examines the complex and at times invisible relations between gender and science. Topics include the roles of women and men in the scientific and technical professions, the gendering of "science" and "nature," biological theories of sexual inequality and feminist critiques of scientific methodologies and epistemologies. Another course, "Issues in Women's Health, is an interdisciplinary inquiry into the issues affecting women's health and the politics of gender in the medical health care profession.

OREGON

University of Oregon

Center for the Study of Women in Society
1201 University of Oregon
Eugene, OR 97403-1201
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PHONE: (541) 346-5399
FAX: (541) 346-5096
WEBSITE: http://csws.uoregon.edu/programs/index.html-ssi

PROGRAMS

Ecological Conversations: Gender, Science, and the Sacred
WEBSITE: http://ecocon.uoregon.edu.

This program proposes to foster a spirited dialogue across global and disciplinary borders, inviting fellows to share perspectives on the fundamental philosophical, evolutionary, political and spiritual questions raised by the convergence of women's and environmental movements. The program is dedicated to a forum for critical reflection and scholarly interchange where the assumptions about knowledge and the worlds that shape these movements can be complicated, contested and rewoven. Their goal is to host a series of dynamic conversations where scholars, writers, scientists, theologians and grass-roots activists from different cultural and national contexts can move beyond environmental crisis rhetoric and explore conceptual and ethical vocabularies that meet the challenges of a new millennium. Details are available online.

Women's Health and Aging Research Initiative

The initiative was established to conduct research aimed at furthering the understanding of women's health issues, to ensure that research findings translate into policies and practices that improve women's health and to develop collaborative relationships with other research organizations.

Research Interest Groups (RIG)

Mid-Life/Menopause RIG members meet to discuss issues and review literature and research related to women's health at mid-life and during menopause. Topics vary from discussing scientific hormone studies related to peri-menopause and menopause, to studies and information on memory, to sexuality in midlife and beyond. Alternative health information related to the above topics is also included when research materials are available.

The Wired RIG is a research interest group of the Center for the Study of Women in Society that provides collaborative opportunities for people interested in exploring the Web's use in promoting research on women and gender. Members of the Wired RIG serve as the advisory board of the Wired Humanities Project (a jointly funded project of The College of Arts and Sciences and the Feminist Humanities Project of CSWS). The Wired Humanities Project, a joint venture between the College or Arts and Sciences and the Center for the Study of Women in Society, promotes the use of digital technology in humanities teaching and research. In cooperation with the Wired RIG, the Wired Humanities Project is helping to implement a new initiative to promote the use of computer technology in humanities research and teaching.

RHODE ISLAND

Brown University

Pembroke Center for Teaching and Research on Women
Box 1958
Providence, RI 02912
DIRECTOR: Elizabeth Weed
PHONE: (401) 863-2643
FAX: (401) 863-1298
WEBSITE: http://www.brown.edu/Departments/Pembroke_Center

CONFERENCE

Technology and Representation

In 2001–2002 the Pembroke Seminar will explore the link between technology and mass culture. The seminar will explore why technology has been gendered masculine or associated with a discourse of hyper-masculinity while women are positioned as "incompetent" with respect to its use. Graduate students at the Pembroke Center will investigate the role that such configurations play in the broader social and political discourse on technology, modernization and progress.

UNIVERSITY PROGRAMS

Women in Science and Engineering (WISE)
Mailbox 1939
Providence, RI 02912
PROGRAM COORDINATOR: Beverly Skillings
PHONE: (401) 863-2314
WEBSITE: http://www.brown.edu/Student_Services/WiSE/index.html

WISE was established at Brown University to address the issues faced by women who study the sciences, to create a sense of community of and for women in the sciences at Brown University and to address the challenges women face both in the science classroom and upon entering the workforce as scientists.

PUBLICATIONS

Achieving Gender Equity in the Science Classrooms: A Guide for Faculty

WEBSITE: http://www.brown.edu/Administration/Dean_of_the_College/homepginfo/equity/Equity_handbook.htm

This book was developed by the Group Independent Study Project (GISP) on gender distinctions in science education at Brown University. The project, organized by students concerned about the under-representation of women in science, was designed to examine the role that science education plays in that under-representation. In order to examine issues of science education and women in science at other schools, students in the GISP assembled a conference of students from the New England Consortium for Undergraduate Science Education (NECUSE) schools in April 1993. Feedback and experiences from these programs, as well as consultations with NECUSE faculty, form the basis of this handbook. *It is available on-line.*

VIRGINIA

Radford University

Center for Gender Studies

Radford, VA 24142
DIRECTOR: Hilary M. Lips, Ph.D.
PHONE: (540) 831-5792
FAX: (540) 831-6798
WEBSITE: www.radford.edu/~gstudies

RESEARCH

The center is engaged in ongoing research on students' academic self-views and their perceptions of their academic and career possibilities. This research explores, among other things, the persistence of a gender divide in the realm of science and mathematics.

Some of the findings are available online.

WEBSITE: http://www.radford.edu/~gstudies/sources/nz/keyaddr.htm

CONFERENCES

Each year, the Center for Gender Studies hosts a student research conference on gender. Past conferences featured papers on women and science, for example "Gender Differences in EEG During a Sustained Attention Task" (1999); demonstrations on how to use computers for research on gender (1997); and round-table discussion on women and science (1998).

WEBSITE: http://www.radford.edu/~gstudies/conferences/conferences.htm

WASHINGTON

University of Washington

Northwest Center for Research on Women

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Box 351380
Seattle, WA 98195
PHONE: (206) 543-9531
FAX: (206) 685-4490
EMAIL: nwcrow@u.washington.edu
WEBSITE: http://depts.washington.edu/~nwcrow

PROGRAMS

Rural Girls in Science

EMAIL: rural@u.washington.edu.
WEBSITE: http://depts.washington.edu/rural/index.html

The Northwest Center for Research on Women's comprehensive program for rural girls in science, funded by the National Science Foundation, develops partnerships with students, teachers, counselors, parents and community members to create an environment conducive to rural girls' science and math achievement. The summer part of the program includes: Summer Science Program for Rural High School Girls, Summer Science Institute for Rural High School Teachers, Summer Workshop for Counselors in Rural High Schools and a Statewide Conference. In addition to the summer programs, each school-based group participates in ongoing activities during the school year that includes a Long-Term Research Project (LTRP), an Internet science club, and two working meetings.

RESEARCH

Science Career Decisions in College—A Qualitative Approach

This examines the decision-making process for people at various stages in their science, mathematics or engineering careers as a pilot for a larger multi-campus study. The study examines issues affecting career decisions by individuals just out of college, those in graduate school and those in the early years of their careers.

Oral Histories of Women Scientists

To date, 25 women scientists have been interviewed about their work and life histories. Participants represent a wide range of scientific backgrounds and fields, and include graduate students, technicians and faculty members.

Rural Origins of Scientists and Others in Academia (ongoing)

An email survey was developed and sent to all faculty members at the University of Washington. The objective is to assess the impact of single-sex schooling (secondary and higher) and of rural upbringing on women and men in the sciences and other academic fields.

College-Bound Survey

The objective of this study is to examine how parental influence, role modeling and mentoring contribute to academic

success. The project has two parts: the first focuses on the role that family and community play in the process of young people's choosing mathematics, science and engineering careers, and persistence toward the pursuit in these fields. A survey has been developed and administered to first-year undergraduate students at the university. The second part of the project is a survey geared toward faculty, graduate students, and post-docs in the sciences and humanities. It will uncover the rural origins as well as role models and mentors within and outside the individual's family.

UNIVERSITY PROGRAMS

The Center for Women in Science and Engineering (WISE)
University of Washington
Box 352135
Seattle, WA 98195-2135
CONTACT: Suzanne G. Brainard, Ph.D.
PHONE: (206) 543-4810
FAX: (206) 685-4860
EMAIL: uwwise@u.washington.edu or brainard@u.washington.edu
WEBSITE: http://www.engr.washington.edu/~uwwise

WISE is a university-level organization designed to increase the recruitment and retention of women of all ethnic backgrounds in science and engineering (S&E) and to create an academic and social climate at the UW which is conducive to both men and women in S&E at the undergraduate and graduate levels. To attain these goals, the specific objectives of WISE are to build a collaborative and learner-centered environment for women in S&E; deliver recruitment, retention and workforce preparation programs; and conduct research studies related to women in S&E. WISE provides both academic and support programs, including tutoring, professional mentoring, peer mentoring, advising, undergraduate retention interventions, and a graduate program for the recruitment and retention of graduate students. All programs are evaluated annually, documentation on each program is maintained, and a longitudinal database tracks undergraduate students from their entry through graduation. Several research studies have been published on the evaluation of each of the intervention programs.

Annual WISE Conference

Every year, the Center for Women in Science and Engineering hosts a conference that gives students a chance to meet professionals, faculty and staff in engineering and the sciences. The conference gives those practicing in the field the opportunity to share their enthusiasm.

Mentoring

WISE coordinates different mentoring programs to introduce students to experienced individuals, who act as advisors and role models, in their respective fields of interest. Each program uses the "Curriculum for Training Mentors and Mentees in Science and Engineering," developed by WISE to help mentors and students establish a positive and successful relationship. WISE matches students in three different programs: Peer Mentoring Program, Professional Mentoring Program and Graduate Student/Faculty Mentoring Program.

Outreach Programs

WISE collaborates with other organizations on campus and in the community to encourage the exploration of science and engineering.

The Undergraduate Retention Program

The Undergraduate Retention Program is a longitudinal study designed to track individual females who are interested in pursuing a degree in science, math or engineering (SME). The study, now in its ninth year, tracks students from entry into the University of Washington as first-year students to the time they graduate or change to non-SME majors. The goals of the study are to determine accurate retention rates of women in SME, examine the factors affecting retention, increase the retention rate of women in SME, and report these factors to the dean and departments involved for consideration in policy development.

c.

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The National Council for Research on Women
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ABOUT NCRW

The National Council for Research on Women (NCRW) is a collaborative of 95 major women's research and policy centers. It was founded in 1981 with 28 centers and has grown to include a large network of concerned individuals and organizations worldwide. As a Non-Governmental Organization (NGO) of the United Nations, NCRW has ties with key international representatives and serves as an umbrella for a global network of scholars.

NCRW's mission is to examine the gendered dimensions of social, economic, and political life and to address the challenges and inequities identified by that analysis. NCRW fosters cutting edge research and builds strong links among the worlds of research, policy, and action in order to effect positive change on behalf of women and girls. NCRW is committed to inclusivity and diversity in all its activities.

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This report is a must for every educator, policy maker, and business leader in America. If we are to keep our national scientific enterprise vital, we must stop the alarming talent shortage that results from the current underrepresentation of women scientists and engineers in academia, government, and industry.... *Balancing the Equation* makes a major contribution to addressing the pipeline challenges by looking for better ways to incorporate girls and women at every stage of the education and employment process.

JANET L. HOLMGREN President, Mills College
Chair, Women's College Coalition
Board Chair 2001–2002, American Council on Education

Thanks to this splendid report from the National Council for Research on Women, everyone can see solid evidence about which glass ceilings are cracking and which are not, and why. Authoritative in its combination of analysis with advocacy, the volume is a must-read for all who care about our nation's next generation of girls and women in science and engineering.

RODNEY NICHOLS President and CEO, New York Academy of Sciences

Our nation must ensure that we utilize the talent of our entire population, not just a narrow slice of it. *Balancing the Equation* presents opportunities and strategies to assure full participation and achievement in the sciences by women and girls.

U.S. REPRESENTATIVE CONNIE MORELLA

Balancing the Equation calls upon all adults to support the interest and persistence of girls and women in science, engineering and technology. At Girls Inc. we know the energy and excitement girls bring to discovering the natural world and taking machines apart. The report tells us we must all go further to see girls' early excitement sustained....When our efforts are successful, everyone will benefit from a more equitable world and more humane science and technology.

JOYCE ROCHÉ President and CEO, Girls Incorporated

Launched at a crucial moment, *Balancing the Equation* provides a blueprint of specific programs, best practices, and recommendations to attract and retain women and girls in science, engineering and technology at each critical juncture.

SUE ROSSER Dean, Ivan Allen College, Georgia Institute of Technology

Balancing the Equation provides recommendations and words of wisdom for transforming the culture and values of science, engineering and technology (SET), and strategies for documenting the transformation....It is about harnessing our intellectual capital in future leadership in SET. While it celebrates the progress for girls and women in SET, it makes the case for renewed resources and responsibility for all to ensure a strong economy based on SET.

YOLANDA GEORGE Deputy Director, American Association for the Advancement of Science

Understanding the issues addressed in *Balancing the Equation* is critical to the scientific and technological future of our country. The book provides an excellent framework for creating a science and technology that benefits from women's knowledge, concerns, and ways of approaching problems. The Directory of Resources is unparalleled and the Conversations About the Future gave me a challenging glimpse of what could be.

JANE ZIMMER DANIELS Clare Boothe Luce Program Director, The Henry Luce Foundation
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